THE AMERICAN

JOURNAL OF PHARMACY.

JANUARY, 1888.

ON THE ANALYSIS OF BITTER WINE OF IRON.

A Contribution from the Chemical Laboratory of the Philadelphia College of Pharmacy.

By Herman J. M. Schroeter.

Read at the Pharmaceutical Meeting, December 20, 1887.

In discussing this subject it is the object of the writer to show by analysis the differences which exist between commercial and officinal bitter wine of iron, and at the same time propose a method for its assay.

It was thought desirable to have a standard for comparison, therefore a sample was made according to the formula of the U. S. P. 1880.

In order to be sure of the most important ingredient—the solution of citrate of iron and quinine—the manufacture of it was started by preparing from chemically pure ferrous sulphate the solution of tersulphate of iron, which was converted into ferric hydrate and used for preparing the solution of citrate of iron and ammonium, from which was obtained the salt in transparent garnet red scales. From this, then, the solution of citrate of iron and quinine was prepared. The white wine used, in preparing the stronger white wine, had the specific gravity of 1.027 at 20° C., and an alcohol strength by weight of 15.25 per cent.

To compare with the officinally prepared bitter wine of iron five samples were procured in the market from different sources. For aid

in reference to the different samples I will designate that prepared by myself No. 1., and the consecutive numerals to 6 for those investigated.

Physical properties.—The officinal product could be described in regard to physical properties as follows: a greenish-yellow-brown syrupy liquid, having an agreeable orange and vinous odor, a bitter and mild ferruginous taste, a slightly acid reaction, and the specific gravity from 1.110 to 1.120.

In physical properties, compared with No. 1, the other samples shared quite a range of differences. No. 2 alone showed the peculiar greenish color, which is due to the solution of citrate of iron and quinine. In the other the color varied from light to dark reddish-brown. But one sample, No. 5, possessed the bitter taste equal to No. 1. Nos. 2, 3 and 4 were not quite so bitter, and No. 6 was almost destitute of bitterness. The specific gravities varied from 1.041 to 10·91 at 20° C.

Determination of alcohol.—The method used was that recommended by the pharmacopœia for white wine. The percentage in No. 1 was found to be 20·5 by weight. Nos. 2, 3 and 5 showed respectively 15·75 per cent., 14·27 per cent. and 13 per cent.; Nos. 4 and 6 somewhat lower, 9·57 per cent. and 9·36 per cent.

Dry residue, ash and iron.—The dry extract was obtained by evaporating 20 gm. at a temperature of 100° to 110° C., until no further loss of weight occurred, and was found to be 13.25 per cent. in No. 1, and varying from 5.65 per cent. to 11.20 per cent. in the others. The ash was obtained by ignition at a red heat until a fixed weight remained. The color varied from light-gray in No. 2, to red-brown in No. 1, and the amount from 0.7 per cent. in No. 1, to 2 per cent. in one of the others. From this ash the iron was estimated by dissolving in hydrochloric acid, evaporating excess of acid and precipitating with ammonium hydrate, washing thoroughly with hot water, igniting and weighing as ferric oxide. No. 1 showed the highest, 0.5 per cent., the lowest being 0.225 per cent.

Estimation of quinine.—In assaying the amount of quinine present, the following method of extracting the alkaloid was resorted to: 20 gm. of the bitter wine of iron were placed in a glass separator; to this was added an aqueous solution of 0.1 gm. of tartaric acid and then solution of soda in slight excess. This was then agitated with four successive portions of chloroform, each of 10 c.c. After separa-

ting the chloroformic layers and mixing them, they were evaporated in a tared beaker on a water-bath, and the residue dried at a temperature of 100° C. From the weight of the residue the percentage of the alkaloid was calculated. The residue from No. 1 weighed 0.096 gm., equal to 0.48 per cent. of quinine present. The results obtained from the other samples proved but two of them to contain the officinal article. These two, Nos. 4 and 5, were assayed with a result of 0.125 per cent. and 0.45 per cent. of quinine. No. 4, therefore, being only of ¼ the officinal percentage, and No. 5 lacking but 0.03 per cent. The solutions of these alkaloids in water acidulated with dilute sulphuric acid, had a vivid blue fluorescence and responded to the following tests and reactions for quinine:

1. To a portion of the solution fresh chlorine water was added, and then NH_4OH in slight excess, when a green color was produced due to thalleioquin.

2. To another portion chlorine water was added, then a few drops of $K_4Fe(CN)_6$, and finally a few drops of NH_4OH, a red color was produced, which rapidly faded.

3. KOH added to another portion formed a white precipitate, insoluble in an excess. NH_4OH also produced a white precipitate, soluble in an excess.

The residues from Nos. 2 and 3 for alkaloid were found to represent respectively 0.4 per cent. and 0.225 per cent., the former therefore within 0.08 per cent., the latter less than ½ the officinal percentage. The above mentioned tests for quinine were applied to acidulated aqueous solutions of the suspected alkaloids, but with negative results in both cases; these acid solutions also having but an exceedingly faint fluorescence. The following tests for cinchonidine were then applied to these two solutions, and with positive results:

1. On adding NH_4OH to some of the solution a white precipitate was formed, which was almost insoluble in an excess.

2. To another portion of the solution $KNaC_4H_4O_6$ was added in slight excess and allowed to stand a short time; to the filtrate was added a drop of NH_4OH. Not more than a slight turbidity resulted, showing the absence of more than traces of the other cinchona alkaloids.

The residue from No. 6 showed only 0.05 per cent., about 1–10 the percentage of No. 1.

The above mentioned tests for quinine and cinchonidine, also other

cinchona alkaloid reactions, were applied to an aqueous solution of this residue, but with negative results. This solution was neither precipitated by tannic or picric acid, nor potassio-mercuric iodide, indicating the absence of most alkaloids. It is believed that sample No. 6 does not contain any trace of the cinchona alkaloids, nor any other active organic ingredient. Several tests for morphine were applied to the alkaloidal residues obtained from the samples, but all with negative results.

Determination of citric and tartaric acids.—The presence or absence of citric acid in the samples was also ascertained by recognized methods. The officinal article contains citric acid alone, as used in preparing the solution of citrate of iron, and also again in the solution of citrate of iron and quinine. Nos. 3 and 4 showed the presence of citric acid alone. No. 2 gave, with the tartaric acid tests, very decided results; this also showed a very small trace of citric acid present. Nos. 5 and 6 could be made to respond to tartaric acid tests alone, and proved the total absence of citric acid. It was suggested that the tartaric acid tests were responded to, due to the probable existence of traces of this acid present in the wine, which was used in preparing the bitter wine of iron. But this seemed impossible according to the results gotten. The amount of liquid used was small, and the results obtained were so decided to suggest more than such traces. The following test for citric acid was used:

To a portion of the liquid KOH solution was added and boiled; the precipitate, consisting of the hydrated iron, was filtered out. To the cooled filtrate was added test-solution of calcium chloride and allowed to stand some time, then filtered. The new filtrate, when heated to boiling, afforded a white precipitate, due to citrates.

The following tests for tartaric acid were used:

(1.) To a portion of the liquid was added test-solution of nitrate of silver, and then a few drops of NH_4OH; on boiling, a mirror of metallic silver was formed on the test tube.

(2.) Another portion of the liquid was deprived of its iron by boiling with KOH solution; the cooled filtrate was then supersaturated with acetic acid, and yielded a white crystalline precipitate due to tartrates.

The percentage of sugar in each sample was not estimated.

Below will be found a table showing the results gotten from each sample as described above:

	U.S.P., No. 1.	No. 2.	No 3.	No. 4.	No. 5.	No. 6.
Color.	greenish, yellow-brown.	very dark greenish-brown.	dark reddish-brown	reddish-brown.	light reddish-brown.	reddish-brown.
Taste.	very bitter.	bitter.	medium bitter.	medium bitter.	bitter.	not bitter.
Sp. gr. at 20° C.	1.114	1.062	1.049	1.041	1.091	1.044
Per cent. of alcohol by weight.	20.5 p. c.	15.75 p. c.	14 27 p. c.	9.57 p. c.	13. p. c.	9.36 p. c.
Fixed residue.	13.25 "	10.15 "	10.30 "	8.075 "	11.20 "	5.65 "
Ash.	0.70 "	1 80 "	1.41 "	1.475 "	2.00 "	1.40 "
Fe_2O_3.	0.50 "	0 42 "	0.475 "	0.35 "	0.48 "	0.225 "
Alkaloid.	quinine. 0.48 p. c.	cinchonidine. 0 40 p. c.	cinchonidine. 0.225 p. c.	quinine. 0.125 p. c.	quinine. 0.45 p. c.	undetermined. 0.05 p. c.
Citric or Tartaric acid.	citric acid.	tartaric, trace of citric acid.	citric acid.	citric acid.	tartaric acid	tartaric acid

As no method for assaying this preparation is offered by the Pharmacopœia, it occurs to the writer that the following directions might aid in its examination:

Note physical properties, which should not be far from those described above, with a specific gravity of 1.110 to 1.120. Estimate alcohol by the method given, the amount by weight should not be far from 20 per cent. Determine dry extract by evaporation on a water-bath to constant weight, ignite this and determine percentage of ash; from which estimate the iron. Treat 20 gm. of the solution of bitter wine of iron with 0.100 gm. of tartaric acid, add sodium hydrate in slight excess, agitate with four successive portions of chloroform, mix these four chloroformic extractions, evaporate to constant weight, and weigh; the yield should be 0.48 per cent. Determine the identity of this alkaloidal residue. Finally apply tests for citric and tartaric acids, those for the former acid in a complex mixture can only be of a confirmatory character, but those for the latter one are more positive; for, when the silver mirror is obtained, there is little room left for doubt.

Sodium boratc, to which the absurd name "antifungine" has been applied, is recommended in solution (fifteen per cent.) in the treatment of diphtheria. It is applied locally by the spray or with a soft brush, and is also to be taken internally in doses of from five to twenty minims.—*Quart. Therap. Rev.*

EXTRACTUM ASARI FLUIDUM; FLUID EXTRACT OF WILD GINGER.

Contribution from the Pharmaceutical Laboratory, Philadelphia College of Pharmacy.

By F. P. Streeper.

Read at the Pharmaceutical Meeting, December 20, 1887.

Having undertaken a series of experiments to determine a menstruum which would most effectively exhaust asarum, and hold in solution the volatile oil and resin to which the medicinal properties are probably due, three fluid extracts were made of different alcoholic strengths and numbered Nos. 1, 2, and 3.

No. 1.—150 grammes of ground asarum was moistened with 95 per cent. alcohol, and tightly packed in a conical percolator, a sufficient quantity of the requisite menstruum was then added to thoroughly saturate the drug and leave a stratum above it; when the liquid commenced to drop from the percolator, the lower orifice was closed, and having closely covered the percolator, maceration was allowed to proceed for forty-eight hours. Percolation was then commenced, gradually adding alcohol until the drug was thoroughly exhausted, the first 135 c.c. of the percolate was reserved, the remainder evaporated, by means of a still, to a soft extract, and the alcohol collected. The soft extract was dissolved in the reserved portion, and enough alcohol added to make the fluid extract measure 150 c.c.

This furnished a perfectly transparent liquid of a rich, amber color, with an agreeable, aromatic, strongly persistent odor, and pungent, warm and lasting taste, and showed no indications of precipitating after standing for several weeks, and beyond a doubt holds in solution the active principles of the drug.

No. 2.—150 grammes of the ground drug was taken as before, macerated and percolated, using, however, a menstruum consisting of three parts of alcohol and one part of water, corresponding to 71¼ per cent. of absolute alcohol; the operation was conducted in precisely the same manner as the preceeding. This furnished a darker fluid extract than No. 1, no doubt due to the more aqueous menstruum dissolving more of the coloring matter, but the soft extract obtained by distilling and evaporating the percolate was mostly insoluble in the reserved portion, and deposited as an oily, resinous precipitate. This fluid extract on standing for several weeks deposited yellowish-white

stellate crystals, which were not further examined. These crystals were not noticed in either one of the other two fluid extracts.

No. 3.—150 grammes of the ground drug was taken, as in each of the preceding cases, and exhausted, using a menstruum consisting of two parts of alcohol and one part of water, corresponding to 63⅓ per cent. of absolute alcohol, the most aqueous menstruum used. This finished fluid extract is darker than either of the preceding ones, showing that the coloring matter is dissolved principally by the water, and as in the case of No. 2, it precipitated most of the volatile oil and resin, which had been extracted by the alcohol, leaving in solution in the aqueous menstruum but a small portion of the active principles.

From the foregoing experiments it will be seen that in cases where a drug owes its activity to volatile oil and resin, and a large quantity of either is present, as is the case with asarum, a menstruum of 95 per cent. alcohol or nearly this strength is absolutely necessary, if it is desired to thoroughly exhaust the drug of these principles and retain them permanently in solution in the finished fluid extract.

EXTRACTUM CIMICIFUGÆ FLUIDUM; FLUID EXTRACT OF CIMICIFUGA.

Contribution from the Pharmaceutical Laboratory, Philadelphia College of Pharmacy.

By Edwin C. Lesher.

Read at the Pharmaceutical Meeting, December 20, 1887.

The investigation of the active principle of medicinal plants, and the determination of the menstruum for extracting the same, is a work attended with no little trouble. Having made a number of experiments to ascertain the best menstruum that would produce a fluid extract of cimicifuga, the following results are hereby recorded:

Formula No. 1: Cimicifuga in No. 60 powder, 8 ounces av.; alcohol sufficient to make 8 fluid-ounces. Moisten with 2 fluid-ounces of alcohol.

Formula No. 2: Cimicifuga in No. 60 powder, 8 ounces av.; diluted alcohol sufficient to make 8 fluid-ounces. Moisten with 2 fluid-ounces of diluted alcohol.

Formula No. 3: Cimicifuga in No. 60 powder, 8 ounces av.; alcohol, 2 parts; water, 1 part. Moisten with 2 fluid-ounces of the menstruum.

Formula No. 4: Cimicifuga in No. 60 powder, 8 ounces av.; alcohol, 3 parts; water, 1 part, sufficient to make 8 fluid-ounces. Moisten the powder with 2 fluid-ounces of the menstruum.

Pack firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and have a stratum above it; when the liquid begins to drop from the percolator, close the lower orifice and macerate for forty-eight hours. Then allow the percolation to proceed, adding menstruum until the cimicifuga powder is exhausted. Reserve the first six fluid-ounces, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion and add enough menstruum to make eight fluid-ounces.

In making these experiments the alcohol was recovered by the use of the still, and after having ascertained its specific gravity, converted into diluted alcohol.

The making of fluid extracts is not a difficult operation in the hands of the practical pharmacist. It cannot be too strongly urged that a druggist should make his own fluid extracts. It is in these more especially, that manufacturing pharmacists have almost a monopoly, and will continue so to have as long as the drugman is disinclined to help and work for his own individual interest. The making of these give him, 1st, confidence in his own ability; 2d, practical knowledge which he cannot know or remember as well, simply from books; 3rd, assurance that his extracts are not only what he represents them to be, but that none are better, if any are as good; 4th, respect and confidence from the physician, who must needs feel that such a druggist is progressive, and trying to keep up the advance of pharmacy.

On examination of the different residues it was found that the one in which three parts of alcohol and one of water, as the menstruum, was used was entirely exhausted; the extract was of a very good quality, if not superior to the one in which alcohol was used as the menstruum.

Poisoning with Iodol.—Pallin gives an account of a case of necrosis of the clavicle in which an operation was performed, and seventy-five grains of iodol were applied to the wound. During the evening of the same day the patient became delirious, and on the following day his temperature was 102.2° F., his pulse was 136, small and irregular, and he vomited and was apathetic. The urine showed traces of albumen and a weak iodine reaction. Although the dressing was changed at once, all the iodol being washed out of the wound and bismuth applied in its place, the symptoms of poisoning lasted four days longer, and for a fortnight iodine was to be recognized in the urine.—*N. Y. Med. Jour.*

PRACTICAL NOTES IN PHARMACY.

Abstracts from Theses.

Mucilago Acaciæ.—With the view of rendering the mucilage of gum-arabic permanent, George P. Ringler, Ph. G., suggests to prepare it by dissolving 4 ounces of the gum in a mixture of 4 ounces each of glycerin and water. The solution is effected in the usual way by maceration and agitation, and usually requires straining to free it from accidental impurities. It is particularly well adapted for the preparation of

Syrupus Acaciæ, by mixing 3 parts of the mucilage with 5 parts of simple syrup. The syrup should be prepared extemporaneously, since it will not keep long in warm weather without spoiling.

To ascertain the preservative influence of glycerin upon the solution of gum, the mucilage prepared according to the Pharmacopœia, and several samples containing glycerin were simultaneously exposed to a temperature varying between 65° and 80° F., and it was found that the former would keep for about one week; while a menstruum composed of 28 water and 16 glycerin would render the mucilage serviceable for two weeks; a mixture of 24 water and 10 glycerin for five weeks, and a mixture of 20 water and 15 glycerin for more than seven weeks.

Tinctura Vanillæ.—While retaining the pharmacopœial percentage of vanilla in this preparation, John K. Faust proposes changes in the menstruum and in the manipulation. Instead of using sugar for beating the vanilla into powder, he suggests the use of washed sand for this purpose, but in much larger proportion than has been employed by Mr. Chas. Shivers (Am. Jour. Pharm., 1861, p. 383). The menstruum contains glycerin, the alcoholic strength is reduced, and maceration in the percolator, for a short time, is resorted to. Cut vanilla, 10 parts, is beaten into a uniform powder with washed sand, 75 parts, the mixture packed into a percolator, and macerated for four hours with sufficient menstruum composed of alcohol 50 parts, glycerin 19 parts and water 31 parts; percolation is then allowed to proceed until 100 parts of tincture have been obtained.

Syrupus Sarsaparillæ Compositus.—In 1878 Mr. Isaac Davis proposed (Am. Jour. Pharm., 1878, p. 327) the preparation of this and other syrups by percolating the drugs, suitably powdered, with simple syrup. Irvin J. Brandt, Ph. G., now suggests a modification of this

process, by combining the process of dissolving the sugar with that of exhausting the powdered drugs. For the syrup named he proposes the following manipulation: Reduce to a number 20 powder the following drugs: sarsaparilla, 12½ ounces, avoirdupois; guaiacum, 1½ ounces; pale rose, 1 ounce; glycyrrhiza, 1 ounce; senna, 1 ounce; sassafras, ½ ounce; anise, ½ ounce, and gaultheria, ½ ounce. Moisten the powder with a menstruum composed of 1 part of alcohol and 7 parts of water; when thoroughly saturated transfer to a percolator, pack firmly, cover with a piece of filtering paper; upon this place 50 ounces of sugar, and gradually add more menstruum until the percolate begins to drop; then close the lower orifice, macerate for forty-eight hours, and finally percolate until 3½ pints of syrup are obtained.

Syrupus Scillæ Compositus was made by the same process and with equally good results, a small quantity of ammonia having been added to the menstruum with the view of holding the pectinaceous principle of senega in solution.

Commercial Lard.—Norman G. Ritter, Ph. G., prepared lard according to the Pharmacopœia from the internal fat, the leaves, the loss from the weight of the crude fat being 7.5 per cent. Comparing it (No. 1 of the table below) with a number of commercial samples; the following results were obtained. The process of analysis is not given:

NO.	MELTING AT	CLEAR AT	WATER PRESENT.	SALTS PRESENT.
1	88° F.	95° F.	———	traces KCl and NaCl.
2	86° F.	93° F.	9.5 per cent	0.75 per cent. KCl, NaCl.
3	86° F.	93° F.	———	traces of chlorides.
4	82° F.	92° F.	.2 per cent.	0.75 per cent. chlorides and carbonates.
5	86° F.	93° F.	1.75 per cent.	0.5 per cent. chlorides.
6	86° F.	93° F.	2.0 per cent.	0.5 per cent. chlorides.
7	86° F.	93° F.	3.0 per cent.	0.5 per cent. carbonates.
8	82° F.	92° F.	4.5 per cent.	traces of chlorides.
9	82° F.	92° F.	———	0.5 pr. ct. chlorides with trace of alum.
10	82° F.	92° F.	0.5 per cent.	0.5 per cent. carbonates.
11	82° F.	92° F.	7.0 per cent.	0.5 per cent. chlorides.

Aside from the water and salts found in most, the commercial specimens consisted either entirely of the external fat, or of mixtures of the internal and external fat, as indicated by their melting points. The cost of the lard, rendered by the author, was from 10 to 16 per cent. less than that of the samples examined.

Unguentum Hydrargyri.—Wm. M. C. Craine, Ph. G. examined a number of specimens of mercurial ointment obtained from pharmacists and from manufacturers, with the view of determining the amount

of mercury oxides present. The ointment was digested with benzin to remove fat, and the residue treated with alcohol to dissolve resinous matters; the metallic residue was weighed, treated with dilute nitric acid and again weighed; the amount dissolved by the acid was noted as mercury oxide, no account being taken of the possible presence of other metals.

Ointments sold as containing 50 per cent. of Mercury.			Ointments sold as containing 33⅓ per cent. of Mercury.		
NO.	MERCURY FOUND.	OXIDE FOUND.	NO.	MERCURY FOUND.	OXIDE FOUND.
1	48. per cent.	1.125 per cent.	1	29.6 per cent.	.75 per cent.
2	37.375 per cent.	.75 per cent.	2	33.25 per cent.	.85 per cent.
3	49.125 per cent.	2. per cent.	3	33.75 per cent.	.675 per cent.
4	49. per cent.	.875 per cent.	4	31.75 per cent.	.6875 per cent.
5	33.75 per cent.	.5 per cent.	5	26.5 per cent.	.5 per cent.
6	29.4 per cent.	trace per cent.	6	31. per cent.	.633 per cent.
7	42.5 per cent	1.5 per cent.	7	32 125 per cent.	.84 per cent.
8	51.25 per cent.	1 6 per cent.	8	31. per cent.	.6 per cent.
Average	42.5 per cent.	1.044 per cent.	Average	31.122 per cent.	.692 per cent.

Commercial Petrolatum.—John G. Patton, Ph. G., examined a number of samples, as to color, melting point, solubility in 64 parts of boiling alcohol, treatment for two hours with sulphuric acid, specific gravity 1.54, and heating upon platinum foil. Each sample was also digested for half an hour with an equal weight of soda and five parts of water, the aqueous liquid being then supersaturated with dilute H_2SO_4, to determine the presence of oily or resinous matters.

The results tabulated are as follows:—

Sample from	Color.	Begins to melt.	Melts at	Alcohol treatment	Effect of H_2SO_4	Vapors from Platinum foil.	Treatment with soda.
New York	yellow amber.	28° C.	36° C.	insoluble.	considerably darkn'd	not acrid.	no oil.
Philadelphia.	orange yellow	37° C	45° C.	insoluble.	slightly darker.	not acrid.	no oil.
Binghamton.	orange red.	39° C.	48° C.	insoluble.	much darker.	acrid.	trace of oil.
Philadelphia.	orange yellow	39° C.	47° C.	insoluble.	slightly darker.	not acrid.	no oil.
Cleveland	yellowish	32° C.	39° C.	insoluble.	very slightly darker.	not acrid.	no oil.
New York	dark orange	31° C.	40° C.	insoluble.	much darker.	acrid.	trace of oil.

Chloral hydrate is rabies.—Brown-Séquard report a series of experiments on rabbits and birds, in which he produced a kind of rabies by injecting oil of tansy. This rabies he was able to control by the vapor and subcutaneous injections of chloral. Brown-Séquard thinks that, from analogy, chloral is a preventive of true rabies.—*L'Union Méd.; Jour. Amer. Med. Assoc.*, Dec. 10, 1887.

ABSTRACTS FROM THE FRENCH JOURNALS.

Translated for the AMERICAN JOURNAL OF PHARMACY.

PICHI.—In an article on *Fabiana imbricata* (*Jour. de Phar. et de Ch.*, Nov. 1, 1887). Nivière and Liotard "conclude that pichi contains no alkaloid, and that its therapeutic action is due to a glucoside resembling æsculin." As such investigations are often widely quoted, it is proper to state that Limousin suspected the presence of an alkoloid in fabiana; that its presence was indicated by Dr. Rusby in 1885; and that Dr. Lyons found less than 0.1 per cent. of this alkaloid. (See AM. JOUR. PHAR., 1886, p. 71. Dr. Lyons also showed the resemblance to æsculin of the fluorescent principle of fabiana.)

STROPHANTUS AND STROPHANTINE. At a meeting of the *Societé de Phar.*, (*Nov.* 2), several members presented observations upon the therapeutic uses of the plant. It was found that the different species were very variable as to physiological activity, some of them being almost valueless. Mr. Wurtz remarked, concerning strophantin, that its present price—60 francs per drachm—prevented its use in therapeutics.

PILLS OF TERPINOL.—Tanret's formula is given as follows in *Nouv. Rem.* Dec. 8, 1887: terpinol and benzoate of sodium, āā 1 gm.; sugar, q. s. Make 10 pills; dose 5 to 10 pills daily.

THERAPEUTICS OF TEREBINTHINA AND DERIVATIVES.—Dr. Dujardin Beaumetz places the substances thus, in the order of their value: for maladies of the bladder: oil of turpentine, terpin, terpinol; for maladies of the bronchia: terpinol, terpin, oil of turpentine. *Nouv. Rem.*, Dec. 8, 1887.

METHYLAL, according to a recent work by Mairet and Combemalle, though without effect in alcoholic insanity and in the early stage of simple insanity, generally succeeds in the crises of the latter; in the insomnia of simple dementia; in atheromatous dementia, and in paralytic dementia. The doses necessary to induce sleep in these cases vary from 5 to 8 gm. In five or six days, patients become so habituated to it that the amount of sleep then diminishes, even if the dose be augmented. Intervals of two or three days should therefore elapse between each series of doses. The action of methylal is exclusively hypnotic; its use has never caused functional troubles of the great organs. It is so safe, so easily prepared and so agreeable to patients that it should have a place in hypnotic medication in mental alienism.

Rech. sur l'act. phys. de meth., Montpellier, 1887; *Le Prog. méd.*, October 29.

IODOFORM DEODORIZED.—In the *Bull. gén. de Thérap.*, November 15, 1887, Mr. Cantrelle, pharmacist, after remarking that all of the substances used for the purpose indicated have proved valueless, recommends the following: iodoform, 1 gm.; menthol, 5 cgm.; oil of lavender (fine), 1 drop. The writer states that in this mixture the odor of iodoform will remain masked as long as the dressing remains in use.

CHLORAL AND IODOFORM: THEIR ACTION UPON CERTAIN MERCURIC SALTS.—In a paper thus entitled (*Jour. de Ph. et de Ch.*, December 1, 1887), Mr. S. Cotton arrives at the following conclusions: 1. Chloral reduces the mercuric acetate with the liberation of carbonic acid and the formation of mercurous acetate. 2. Chloral reduces the mercuric nitrate and liberates carbonic acid, forming calomel. 3. Iodoform reduces the mercuric acetate with the disengagement of carbonic acid and the formation of mercurous acetate, precisely as with chloral. 4. Iodoform does not reduce the mercuric nitrate; its action is limited to the formation of the corresponding iodide. 5. Chloroform and bromoform do not act upon these salts.

HYDROCYANATE OF CHLORAL.—This preparation is proposed by Hermes to replace the uncertain mixtures known as aqua laurocerasi, aqua amygd. amar., and their analogues. The physiological action of hydrocyanate of chloral is thought by Pinner and Bischoff to be the same as that of pure hydrocyanic acid; the formula presented is $CCl^3—CH\begin{cases} OH \\ CN \end{cases}$. The aqueous solution gives pulverulent crystals forming in rhombs or prisms. It is readily soluble in water, alcohol and ether. With the vapor of water it volatilizes slightly, and decomposes into chloral and hydrocyanic acid. Alkalis also decompose it, with a reproduction of hydrocyanic acid. It is very stable. One part of anhydrous hydrocyanic acid is equal to 6·46 of hydrocyanate of chloral. To obtain a solution of equal activity to aq. dest. amygd. amar., 6 cgm. hydrocyanate of chloral is dissolved in 10 gm. of water.—*Ph. Cent., Arch. de Phar.*, Dec. 5, 1887.

REACTION OF COTTON-SEED OIL.—Treated with subacetate of lead and a caustic alkali, cotton-seed oil gives, almost immediately, an orange-red reaction. This, according to Mr. Labiche, a French pharmacist, is peculiar to this oil, for almond, castor, olive, poppy, rape

and cod-liver oils give a milky mixture, which is also the case with butter when thus treated. Mr. Labiche mixes equal parts of the oil and a saturated solution of neutral acetate of lead, and adds ammonia, stirring briskly. The acetate decomposes and the nascent oxide reacts upon the oil. Then the red color appears. After standing, the surface turns orange-red and the lower portion becomes grumous. If 20 per cent. of cotton-seed oil be present the coloration appears at once; lesser quantities show on the surface after the mixture has remained standing for a time.—*L'Union Ph.*, Nov., 1887.

Capric Acid.—A new source of this acid has been found by A. and P. Buisine (*Acad. des Sci.*, Oct. 10), in the washings of wools. When these waters are slightly acidulated, a complex, fatty matter is separated, which is found mixed with fat acids in saponification with potash; and also neutral fatty principles are present, held in emulsion in the liquid. This fat is the first matter from which we extract capric acid; it gives about five per cent. But capric acid in quantity is not present in the fresh washings of wools; they must be old, *i. e.*, have undergone fermentation before much of the acid can be found. The authors state that this "augmentation is due to the action of microbes, for it is not found in sterilized waters." They say furthermore "that this formation of a fat acid by microbes is interesting, from the fact that up to this time we have had no knowledge concerning the mode of generation of fatty substances." *Moniteur Scientifique*, Nov. 1887.

Distillation of Citric Acid with Glycerin.—In a note to the *Acad. des. Sci.*, Clermont and Chautard report as follows: "The formation of pyruvin as the unique product of the distillation of a mixture of citric acid and glycerin, is a curious and unexpected result. We know that pyruvin is obtained from the distillation of tartaric acid with glycerin, and it is difficult to understand how we get the same substance under the same conditions, from so different a compound as citric acid. Erhardt succeeded in preparing pyruvin by distilling glyceric acid with glycerin. It appears probable that in our operation the pyruvin originates in this way, and that the glyceric acid is formed in the course of the reaction at the expense of the glycerin or the acrolein. We could isolate no other product in our process. We sought carefully for the pyrocitric acids, but could find no trace. We were obliged to admit that the citric acid was entirely destroyed." *Moniteur Scientifique*, Nov. 1887.

SACCHARATED OXIDE OF IRON.—Traub, of Berlin, agrees with Hager, that this preparation represents a combination of ferric saccharate and sodic saccharate, in which the latter determines the solubility of the former. In presence of an excess of soda, a relatively smaller amount of sugar is needed to hold the ferric oxide; otherwise a large quantity is needed. The preparation is made by dissolving 100 gm perchloride of iron in 500 ccm. of water, into which is poured a solution of 85 gm. crystallized sodium carbonate in 500 ccm. of water. The precipitate is washed, pressed and mixed with 100 gm. powdered sugar, to which has been added, 1·50 gm. of caustic soda (in plaques) dissolved in 3 gm. of water. The mixture is then evaporated to dryness. The mass is now pulverized, the quantity of iron determined, and a q. s. of powdered sugar added. This saccharate is very soluble. The oxide precipitated by ammonia is not soluble with sugar and soda. *Bull. Com.*, Nov. 1887.

Hager recommended (Commentar, I, p. 723) 33 gm. solution of ferric chloride, sp. gr. 1·282 (containing 29 per cent. Fe_2Cl_6), and 27 gm. cryst. sodium carbonate; the washed and pressed precipitate is dissolved in water, 30 gm.; sugar, 10 gm.; and caustic soda solution (sp. gr. 1·162) 26 gm., the clear solution poured into alcohol, the precipitate dried and properly diluted with sugar.

PRELIMINARY NOTE ON TINCTURE OF QUILLAIA SAPONARIA.

BY PETER BOA.

Having had some experience in the use of quillaia bark for other than strictly medicinal purposes, I had long ago come to the conclusion that an aqueous menstruum was the most suitable for extracting its active constituents. I was therefore somewhat surprised to find that the formula given by the British Pharmaceutical Conference Committee directed the tincture to be made with rectified spirit. It is true that no dose is specified, and as the tincture for which the formula is given is used in the preparation of liquor picis carbonis we may reasonably assume that this was the sole object for which the tincture was designed, and if this be so we can scarcely find fault with it, because for the purpose in question a rectified spirit tincture would be preferable to one less strong in alcohol. However, there is

an increasing demand for tincture of quillaia for internal use; in Edinburgh this has been markedly so since the beginning of this year, when Dr. Claud Muirhead, in the *Edinburgh Medical Journal*, referred in commendatory terms to the administration of the drug in bronchitis, and there is just a possibility that the B.P.C. formula may be taken as a guide to the preparation of the tincture for this purpose. It would, I think, be a pity if it were so taken, because this tincture does not at all represent the virtues of the bark. I have looked up a number of references to quillaia, and I find that all the writers on the subject agree in the conclusion that water is the best solvent of saponin, which is regarded as the active principle of the bark. Gmelin says that saponin is easily soluble in water (1 in 4), more soluble in dilute than strong alcohol, insoluble in absolute alcohol.

Hager gives a formula of an infusion, and a tincture prepared with dilute alcohol.

Grazer, an American pharmacist, recommends for emulsifying purposes a tincture with 3 parts of water and 8 of rectified spirit.

Dr. Claud Muirhead has used with success a decoction.

Collier gives a formula (*Phar. Jour.*, Sep. 20, 1879, *Am. Jour. Phar.*, 1880, 41) for emulsifying purposes with 4 ounces of bark to a pint of rectified spirit; this apparently is the formula copied into the B.P.C. formulary, but made with only half the quantity of bark.

For the purposes of this note I have prepared tinctures of various alcoholic strengths. I take three of these for comparison:

No. 1 is made according to the B.P.C. formula.

No. 2 is made with proof spirit.

No. 3 is made with 3 of rectified spirit and 4 of water.

The time at my disposal since agreeing to bring the subject before this meeting has not been sufficient to enable me to estimate the comparative values of these tinctures except in a somewhat rough and ready way, although I believe the results may be taken to be fairly trustworthy. The quantity of saponin in a tincture may be estimated comparatively by the amount of froth which it produces when shaken up with a quantity of water. Taking the three tinctures above mentioned, adding one-half a drachm of each to two ounces of water in a six-ounce bottle, and shaking, the following results were observed:

No. 1 gave of froth 1.
No. 2 " " " $1\frac{3}{4}$.
No. 3 " " " 2.

A percolate obtained by running a quantity of water, equal to half the quantity of the original tincture, through the marc from the B.P.C. formula, gave nearly as good results as No. 3, showing that the bark had not been exhausted by any means; a percolate obtained in the same way from the proof spirit tincture residue gave very little indication of value. I may say that preliminary mixtures with the water were made with spirit added to Nos. 2 and 3 to make them equal in alcoholic strength to No. 1, in case the spirit might affect the froth test. It was not found to affect the results and has not been added to the specimens shown to illustrate the comparative frothing power. An emulsion made with No. 1 and a fixed oil separated more quickly than one prepared with No. 3. I hope, if time will permit, to determine more accurately the comparative values of these tinctures. However, I have no hesitation in concluding from the result of my experiments that a weak alcohol is preferable to a strong for making tincture of quillaia. In fact I see no use for any alcohol except for preservative purposes.

The question arises: What should be the strength of the tincture? Dr. Muirhead says he gave ℥ss to ℥j of tincture, but, unfortunately, he says nothing about the strength. He mentions, however, that the decoction of which he gave a tablespoonful was made with 5 of bark and 200 of water. A tincture of equivalent strength might therefore, be made with 2 ounces to a pint. To make the tincture appproximate in strength to senega tincture, 1 ounce to the pint would be more than enough.

There is just one point more to which I would allude. The B.P.C. formulary does not specify the part of quillaia bark to be used. Undoubtedly the white portion of the bark is the more valuable; the brown outer portion contains chiefly coloring matter. Both, however, are used together, for I have seen commercial specimens of tincture resembling in color tincture of orange peel. The specimens shown, made from the white portion, are, at most, pale straw color. In making liquor picis carbonis color is of no consequence, and the quantity of bark ordered is greatly in excess of what the menstruum can exhaust, hence, presumably, the want of any specification on this point.—*Phar. Jour. and Trans.*, November 19, 1887, p. 426.

DISPENSING MEMORANDA.

By F. V. Butterfield.

With regard to its importance, dispensing may be considered the "soul" of the chemist's existence; take that away, and he at once degenerates, and descends to the level of the ordinary tradesman. This only serves to show how important it is that the pharmacist should cultivate the *scientific* portion of his business, and thus raise himself beyond the competition of ignorant hucksters and others, who seek to dabble in medicines. I trust the day is approaching when chemists, in general, will be looked upon as a body of public analysts, entrusted with the analyses of potable water, milk, wine, etc.; many of our leading pharmacists occupy this position at the present time.

It behooves us, then, to excel in this important branch of our business, known as the dispensing department, and make ourselves worthy of the confidence of the medical profession. But the question is, Are we doing this? If so, then why are physicians so frequently found to prescribe American pills and extracts and other proprietary pharmaceutical preparations, in preference to those of our own compounding, if ours are equal to them in elegance, and have the great advantage of being *freshly* and scientifically prepared. The "future of pharmacy" is engaging the attention of some of our leading men, and these proprietary preparations, multiplying as they are every day, must have a marked influence on it, certainly a bad one, in substituting *factory-made* mixtures, pills, etc., in place of pure and simple dispensing. Into what it will eventually evolutionize it is impossible to say, but the struggle must end in the "survival of the fittest."

Rule of thumb methods of manipulation, relics of the pharmacy of the past, are but too frequent in the dispensary of to-day, wasting valuable time and generally attended with unsatisfactory results. To take one example of a numerous class—a prescription to be dispensed reads thus:

℞ Strychninæ ..... gr. j.
Excipientis ..... q.s. ut fiant pilulæ sexaginta.

Now, this "excip. q.s." troubles the spirit of the man who pins his faith to "rule of thumb," whereas the efficient dispenser knows *by experiment* that it will require equal parts of confection (rosæ caninæ) and pulv. glycyrrhizæ to make a mass of a proper pilular consistence, and weighing out thirty grains each to form a one-grain pill, has

finished his batch, whilst the former is still trying various excipients, and when done makes them larger or smaller than necessary, and probably too soft.

Ext. cascar. sag. has now become very popular, and owing to its disagreeable taste is frequently prescribed in form of pill, which is often very refractory, it being a difficult matter to prevent them "falling." Pills sent out as hard as they could possibly be made have been too frequently returned *en masse.*

Having had the same difficulty, a few experiments were accordingly tried, and the following method is one which I have used almost daily for a good length of time, and never known to fail.

After trying various excipients, with little success, the softening of the pills and consequent "falling," could only be attributed to absorption of moisture, so, in order to prevent this, a coating of varnish was tried, and proved the supposition to be correct.

In dispensing pills containing ext. cascar. sag., varnishing (or coating with gelatin, etc.) is, therefore, considered a *sine quâ non.*

The commercial extract is usually very soft, when fresh, and, if kept from damp and moisture, becomes harder on keeping, and much more difficult to manipulate. The best way is to at once evaporate it down by means of a water-bath, when it becomes very brittle and is readily reduced to powder, making up to original weight with some inert powder, as sugar of milk, and preserving in a stoppered bottle.

This is the form in which I always use it, and kept thus, it saves much valuable time in rapid dispensing.

To each pill is added ¼ grain each of pulv. tragac. and pulv. althææ, massing with spirit, just adding a few drops of syrup to keep it soft enough for rolling.

Some may think this a rather elaborate and lengthy process, but in practice, which is the chief consideration, it is simple, quick and reliable.

Fel bovinum being also of a hygroscopic nature, can be successfully dispensed in the same manner.

Of course, in selecting a pill excipient there are several important points to be taken into consideration, such as not to increase the size of the pill more than can possibly be helped, not to impair its solubility, nor to have any chemical action on the various ingredients, etc.

Trimethylaminæ hydrochlor. has been much prescribed in a pilular form just recently. This substance occurs in crystals which are ex-

tremely deliquescent, and in practice it is always better to allow them to completely liquefy in the mortar before attempting to make the mass. Out of several excipients tried, pulv. althææ and magnesia answered the best, the former helping to bind the mass and the latter absorbing the superfluous moisture. The strength usually ordered is 2 grains in each pill; this requires 1½ grain of each of the powders.

Among the scale preparations ferri et quininæ cit. and beberinæ sulph. are sometimes ordered in pill; syrup is the best excipient for the former, and glycerin for the latter.

Inf. serpentariæ, prepared strictly according to the present Pharmacopœia, is incompatible with tr. iodi, with which it is sometimes prescribed. It is ordered to be made from the root in No. 20 powder, and thus a certain amount of starch is dissolved out, which, of course, in this case, combines with the free iodine to form iodide of starch, giving a dark-blue inky-looking mixture. This contrasts strongly with a similar mixture made with infusion prepared from the whole root, this remaining quite transparent, and containing free iodine, thus carrying out the intention of the prescriber, which it is the duty of every dispenser to do.

Specimens of the various pills mentioned in the paper, and the two infusions combined with iodine, were handed round for criticism and comparison.—*Phar. Jour. and Trans.*, December 3, 1887, p. 472.

ACTION OF ACIDS ON ZINC CONTAINING LEAD.[1]

By W. Spring and E. Van Aubel.

The authors have investigated the action of hydrochloric, hydrobromic, hydriodic, and sulphuric acids on zinc containing 0·6 per cent. of lead, prepared by melting zinc with litharge. The metal was cast into cylinders 17 mm. in diameter, covered with wax in such a way that only one of the basal planes was exposed to the action of the acid. The hydrogen evolved was collected in the apparatus previously used in investigations on the action of acids on marble (*Bull. Soc. Chim.*, xlvii, 927), and the volume of the gas was read off at regular intervals.

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[1] *Ann. Chim. Phys.* [6], xi, 505–554. Reprinted from *Jour. Chem. Soc.*, 1887, p. 1074.

In all cases, the evolution of hydrogen is not the most rapid at the commencement of the reaction, that is, when the acid is strongest, but the velocity of the reaction increases until it reaches a maximum, and then decreases in such a way that the rate of solution is proportional to the concentration of the acid, and the portion of the curve beyond the maximum is a right line which cuts the axis of the abscissæ at a point corresponding with complete solution. The first part of the reaction, during which the rate of solution increases whilst the concentration of the acid diminishes, is abnormal, and represents a *period of induction.* If the second part of the curve is prolonged backwards, it cuts the axis of the ordinates at a point which gives the initial velocity on the assumption that there is no period of induction.

The theoretical initial velocity as thus determined increases with the volume of the acid used, the surface of zinc exposed remaining constant. Experiments show that the temperature of the zinc rises more rapidly than that of the surrounding liquid, the difference being greater the greater the mass of the liquid. This increase in the temperature of the metal of course increases the rate of solution. If the mass of the zinc varies whilst the exposed surface remains constant, the smaller the mass the higher the rate of solution, the greatest velocity being observed with spheres. This result is due to the fact that the temperature rises more rapidly in the case of the smaller masses. In the case of the more concentrated acids, spheres of zinc were employed, and this introduces a further complication, since the area of the surface is continually diminishing as the action proceeds, and the ratio of the surface to the mass is likewise changing. The correction required is given by the expression

$$S_1 = S^n(\sqrt[3]{n})^2.$$

Metallic zinc has no action on boiling solutions of zinc chloride.

The experiments were made at three different temperatures, 15°, 35°, and 55°, with hydrochloric acid of 5, 10 and 15 per cent., the strengths of the other acids being adjusted so that they were equivalent to the hydrochloric acid solutions.

With the three different concentrations of hydrochloric acid, the ratio of the rate of solution to the concentration of the acid is not the same in all three series when the whole period of solution is taken into account; but if the period of induction is eliminated in the manner already indicated, then the rate of solution in all cases is proportional

to the concentration of the acid. The slight variations of the curves from right lines are due to the differences between the temperatures of the zinc and the surrounding liquid. Measurements of the electrical resistance show that if electrical conductivity exerts any influence during the period of induction, it is without any sensible effect during the second part of the reaction. In order to ascertain the influence of electrolysis during the period of induction, zinc was immersed in hydrochloric acid of 15 per cent. at a temperature of 35°, the surface of the zinc being first covered with a thin layer of gold, platinum, lead, or copper. If the period of induction is due to electrolysis, the rate of solution during that period should vary with the electromotive force of the couple on the surface of the zinc. Possibly also, thermo-electric currents may be produced by the difference in temperature between the zinc and the surrounding liquid, or by differences between the temperature of different parts of the metal itself. Under these conditions, the actual initial velocity is very great, but gradually diminishes until it reaches a minimum, then rises and attains a maximum, and becomes a right line, indicating that the rate of solution is proportional to the concentration of the acid. It is evident from this result that the period of induction is the time during which the acid by slow action produces at the surface of the metal an infinite number of minute galvanic couples by exposing the particles of lead which are disseminated throughout the zinc. The great diminution in the rate of solution is probably due to the fact that the liberated hydrogen removes mechanically the particles of the foreign metal which had been precipitated on the surface of the zinc. The actual velocity at the commencement of the reaction increases in the following order: copper, gold, platinum, lead; whilst the theoretical initial velocity increases in the order, copper, lead, gold, platinum. Neither of these series follows the order of the electromotive force of the couples produced, and hence it is evident that although electrolytic action plays an important part in the solution of a metal in an acid, it is by no means the only determining cause.

No sensible variations in the rate of solution were observed when considerable quantities of sodium or potassium nitrate or sulphates were added to the liquid, and it would therefore seem that the velocity of the reaction is not greatly affected by the internal friction of the solution.

The influence of temperature is shown by a curve the ordinates of

which are the initial velocities whilst the abscissæ are the temperatures. These curves seem to be asymptotic to the axis of the temperatures, and the three curves for the three different degrees of concentration of the acid converge at a point which corresponds with a temperature of −60° to −70°. This result seems to indicate that at a temperature below −70° hydrochloric acid will have no action on zinc whatever the concentration of the acid, and it is of interest to recall the well-known fact that liquid hydrogen chloride, which liquefies at about −70°, has no action on this metal.

According to Kohlrausch, the maximum conductivity of hydrochloric acid corresponds with a strength of 21 per cent. Acid of 25, 30, or 34 per cent., however, dissolves zinc more quickly than acid of 21 per cent., and from this and the previous results it is evident that the conclusion of De la Rive and of Kajander, that the rate of solution is intimately connected with the electrical conductivity of the acid, is not confirmed.

With hydrobromic acid, the rate of solution is much higher than with hydrochloric acid of corresponding concentration. Under ordinary conditions the curve is not a right line at any phase of the reaction, a result due to the fact that with an increased rate of solution the difference between the temperature of the liquid and that of the metal is much greater, and the perturbations due to this cause are greatly increassd. If the conditions are such that the temperature of the zinc is kept constant, it is found that the period of induction is very short, the velocity of solution rapidly attains a maximum, and then decreases with the concentration of the solution, the latter part of the curve being a right line. It is a general result that the period of induction is shorter the greater the concentration of the acid. With hydrochloric acid of 30 per cent., for example, there is practically no period of induction, and the maximum velocity is attained at once. The theoretical initial velocity with hydrobromic acid is 2.29 times that with hydrochloric acid.

With hydriodic acid, the velocity during the period of induction is less than in the case of hydrochloric acid, and the difference is greater the weaker the acids, but after the maximum velocity is attained the rate of solution is the same for both acids, and if the curves are drawn on a small scale they coincide. It follows, of course, that the theoretical initial velocities are practically the same for both acids.

The results with the three haloïd acids are quite different from those obtained in the case of the action of the same acids on marble (*loc. cit.*), in which case the rate of solution is the same for all three. The velocity of the reaction with zinc has no simple relation to the electrical conductivity of the acids, their heats of neutralization, or the solubilities of the salts produced.

With sulphuric acid, the action is very slow, and the rate of solution could not be measured with an acid corresponding with 10 per cent. hydrochloric acid. The period of induction lasts for several hours, and hence the metal was always previously covered with a film of precipitated lead. At 36°, the velocity is only one twenty-seventh of that observed in the case of hydrochloric acid. It is possible that the reaction is not of the same kind as with the haloïd acids. It may be that the formation of zinc sulphate in this way is almost entirely a phenomenon of electrolysis, and that the chemical attraction of the acid for the metal is not the determining cause as with the haloïd acids. In the latter case, there is simple substitution of the metal for the hydrogen of the acid, whilst the formation of zinc sulphate may be the result of a series of reactions, such as $Zn + H_2SO_4 = ZnO + H_2 + SO_3$; $SO_3 + H_2O + Aq = H_2SO_4 + Aq$; $ZnO + H_2SO_4 = ZnSO_4 + H_2O$.

Pure zinc, rubbed on the surface with metallic lead, does not dissolve in acids with a velocity similar to that of zinc alloyed with lead, or zinc covered with lead by precipitation. The black residue left on solution of the zinc containing lead is pure lead. The difference in the electromotive force in these cases may be due to the state of division of the lead, or possibly the black substance is an allotropic modification of the lead. If pure zinc is rubbed with this lead-black by means of a spatula, it becomes more soluble in acids. Mercury amalgamates and dissolves the lead-black, and this is probably the reason why amalgamated zinc is not soluble in acids. d'Almeida's view that amalgamated zinc is as soluble as ordinary zinc, but has the property of condensing on its surface a layer of hydrogen which protects it from the acid, is not supported by any evidence.

Note by Abstractor.—L'Hote has recently shown that perfectly pure zinc does not decompose water, and is not soluble in acids. According to Osmond and Werth, impure zinc when dissolved in acids leaves graphitoidal residues of complicated composition. In one case the composition of the residue agreed with the formula Pb_2Zn.

THE ANTISEPTIC ACTION OF HOPS.[1]

By Dr. Hayduck.

In a previous communication the author had stated, as the result of experiment, that hops do not influence detrimentally the alcoholic fermentation, but that on the other hand they retard the lactic acid fermentation. In a further investigation the author has sought to ascertain to which of the hop constituents this antiseptic action is due.

Oil of hops, as well as the hop tannin, proved inactive in suppressing the lactic acid fermentation. Better results were obtained with the bitter acid, as well as with certain resinous constituents which were separated by the following process:—

The hops were perfectly extracted with ether, and the extract, after removal of the ether, was dissolved in alcohol; this left a residue of a white wax which occurs in hops in considerable quantity, but which is of no importance in brewing. The alcohol solution was then treated with an alcoholic solution of acetate of lead, which threw down an abundant yellow precipitate. This was separated by filtration, carefully washed, and decomposed with sulphuretted hydrogen, yielding eventually a soft resin. The filtrate, after removal of the alcohol, was treated with light petroleum spirit, which took up a second soft resin that was left on evaporation of the petroleum. In the residue there was left a hard resin, which was insoluble in light petroleum spirit, but readily soluble in ether and alcohol.

In this way therefore three well characterized resins were separated from the hops:—

(1) A soft resin, precipitated by lead. If an ethereal solution of this resin be treated with solution of copper sulphate the ether is colored an intense green; the resin therefore appears to form with copper sulphate a green compound soluble in ether. This resin is also soluble in light petroleum spirit.

(2) A soft resin that corresponds with the preceding in being soluble in light petroleum spirit and in giving the copper reaction, but differs from it in not being precipitated by lead.

(3) A hard resin which is not precipitated by lead, does not give the copper reaction, and is insoluble in light petroleum spirit.

The bitter acid is not obtained by this process.

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[1] From the *Pharmaceutische Centralhalle*, Oct, 27; reprinted from *Phar. Jour. and Trans.*, December 17, 1887, p. 500.

All three of the resins behave like weak acids; in aqueous solution they are very instable and readily decomposed. The solubility of the resins in water is not constant, but if a quantity of resin be boiled with successive quantities of water the solubility gradually decreases.

No. 2 resin is related to the bitter acid of hops in that the acid is converted by oxidation into this resin. By numerous experiments it was ascertained that both this and the other soft resin, which appears not to have any relation to the bitter acid, act in a high degree upon the lactic acid bacteria as antifermentatives. On the other hand, the faintly bitter hard resin, which is contained in hops in larger quantity, has little or no antiseptic influence upon the lactic acid bacteria. All that can be said is that in the presence of this resin the development of the lactic acid bacteria goes on more slowly than in its absence. Neither of the resins influences the growth of mould.

The different bitter constituents of hops were also examined as to their influence upon the acetic acid bacteria, and it was found that the development of these organisms was not retarded by the resins.

THE INFLUENCE OF SACCHARIN UPON THE ACTION OF SOME FERMENTS.

By E. J. Millard.

As various vague and conflicting statements have been made as to the anti-fermentive character of saccharin, it was thought worthy of interest to ascertain its influence upon the more common ferments, such as pepsin, pancreatin, diastase and papain.

In all experiments a saturated aqueous solution of saccharin, containing about 0·2 per cent., was employed.

Pepsin.—The usual B. P. test proportions were taken, one experiment having the saturated solution of saccharin instead of distilled water. Maintained at 54°C. for twenty minutes, little or no difference was observable between them, in each case the albumin having been nearly dissolved. To ascertain the exact relationship, they were both at this stage filtered on tared filters, dried and weighed.

The albumin with saccharin solution weighed 16 grains, whilst the normal weighed 13 grains. It is evident, therefore, that saccharin has very little retarding influence over pepsin.

Pancreatin.—The effect of saccharin was tried both with pancreatin upon casein, and also upon starch.

In the former no hindrance was effected by saccharin, and even in large proportions it failed to appreciably affect the value and activity of the proteolytic ferment.

On starch, however, saccharin was found to interfere very materially with the amylolytic property of the ferment, and ten times the amount of ferment was required; but it was also found that if sodic bicarbonate were present in sufficient amount to neutralize the saccharin, no appreciable retardation took place.

Diastase.—Again saccharin showed a distinct retarding action, more than double the quantity of diastasic ferment being required to effect the same amount of conversion of starch as the ferment without saccharin performed. At a meeting of the Manchester Medical Society Dr. Dreschfeld stated that saccharin increases the diastasic power of malt. This is only true if the saccharin is first neutralized with alkali; the increase then, however, is very slight.

Papain.—Saccharin failed to affect to any marked extent the action of a sample of papain upon moist fibrin. The two experiments, the one with, and the other without saccharin, were stopped before complete conversion had taken place, and the undissolved portion filtered, dried and weighed, showed a difference of only a few grains against the saccharin experiment.

In view of the increasing uses of saccharin it is important to note that its antifermentive influence is to a great extent neutralized by the use of alkali, especially when it is employed with the amylolytic ferments; but it hardly seems so essential with the proteolytic ferments.

Professor Salkowsky[1] reports that the antiseptic property of saccharin is greatly dimished when neutralized; in that case it appears that saccharin, like benzoic and salicylic acids, is deprived in a marked degree of its power of affecting the ferments when it loses both its acid nature and antisepticity.—*Phar. Jour. and Trans.*, December 3, 1887, p. 471.

Oat flour in the treatment of burns is recommended by Greene (*Brit. Med. Jour. N. Y. Med. Jour.*), on the score of its freedom from odor, its soothing and anti- septic properties, its superior healing power, its cheapness, and the ease with which it can generally be obtained at short notice. He directs a paste to bemade of equal parts of the flour and fresh (unsalted) lard, to be applied spread on lint or old calico, the application to be renewed every day, or every second day, according to the exigencies of the case.

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[1] *Chem. Zeitung*, December 6, 1886.

URINARY PIGMENTS.[1]

By L. v. Udranszky.

On looking over the literature of the subject of urinary pigments, which extends from the beginning of the present century, it is found that the following conclusions can be drawn from the work at present done on the subject:—(1.) By the action of oxidizing agents, indigo-blue and other indigo compounds, for example, indirubin, can be obtained from normal urine. (2.) In most cases urobilin, which is identical with hydrobilirubin, is also present. (3.) In addition to the foregoing, pigments are obtained by boiling the urine with mineral acids, and are probably derived from the splitting up of certain chromogens in the urine by these strong reagents: to one of these, the name uromelamin is given. It is to the investigation of this third class of pigments that the present research is mainly directed. A litre of normal urine was heated for a quarter of an hour with 5 per cent. hydrochloric acid, and extracted with amyl alcohol; on evaporating the alcoholic extract, a brownish-black, amorphous residue was obtained weighing 0·68 gm. This is the ordinarily received method of obtaining this pigment. The experiment was repeated, using distilled water instead of urine, and a residue weighing 0.51 gm. was obtained, having the same characters, including spectroscopic appearances. The prolonged action of hydrochloric acid in the cold has the same action on amyl alcohol. What this resinous substance is was not further investigated; it was found, however, that the alcohol after distillation still possessed the same action on polarized light as previous to the separation of the pigment from it. This admixture of the resinous substance from the reagents used with the urinary pigment could not be prevented by attempting to wash the acid away from the alcohol by the use of water; it was not found possible to remove the acid in this way. By neutralizing the mixture with chalk, however, the author considers he has been able to obviate this source of error. On account, however, of the unsatisfactory nature of amyl alcohol as a reagent, a method was sought for in which it was not necessary to employ it. The method ultimately adopted was as follows:—Normal urine was evaporated to about one-sixth of its original bulk at 60°;

[1] *Zeit. physiol. Chem.*, xi 537—560. Reprinted from *Jour. Chem. Soc.* 1887., p. 1133.

10 per cent. hydrochloric acid was then added, and after 48 hours the crystals of uric acid thus formed were filtered off. The filtrate was boiled for 18 hours, at the end of which time the remains of the uric acid with an abundance of pigment were precipitated; the filtrate had an orange-red color; to this, chalk and sodium phosphate were added; the bulky precipitate which was formed carried down with it the remains of pigment. The precipitate obtained from the urine by boiling was washed with cold water, hot water, alcohol and ether, dissolved in dilute sodium hydroxide solution, and precipitated by sulphuric acid. This was repeated three times, and the final product was a bright, brownish-black substance, occurring in plates but easily powdered. It was insoluble in cold water, dilute alcohol, ether, and chloroform, sparingly soluble in warm water, absolute alcohol, light petroleum, and concentrated sulphuric and hydrochloric acids. It was easily soluble in amyl alcohol, concentrated ammonia, but especially in solutions of potassium or sodium hydroxide. It can be heated to 115° without decomposition; with soda-lime it yields ammonia; on dry distillation, it gives a smell of formic acid, and after complete combustion leaves a minimal amount of ash which contains no iron. The average quantity in which it occurs in urine is 0·03 per cent. By the action of potash, it yields ammonia, formic acid, acetic acid, butyric acid, palmitic acid (?), catechol, protocatechuic acid, and the residue is free from nitrogen, and has the following percentage composition:—Carbon, 62·26; hydrogen, 3·9; and oxygen, 33·84.

ALDEHYDE RESIN.[1]

By E. Puchot.

Aldehyde resin washed two or three times with warm water and exposed to air becomes hard and friable. It dissolves in alcohol and is precipitated by water. Analysis of two preparations gave the formula $C_{48}H_{64}O_{10} + nH_2O$, n being equal to 4, but the amount of water is variable. When exposed to dry air, the resin gives off water, and its weight gradually reaches a minimum at which it remains constant for some time, and then increases. When the weight is at the minimum,

[1] *Ann. Chim. Phys.* [6], ix, 422. Reprinted from *Jour. Chem. Society*, 1887, p. 1090.

the substance has the composition $C_{48}H_{64}O_{10} = 8\,(C_6H_8O) + O_2$, which varies slightly with the rate of drying. When the increase in weight has become constant, the composition is $C_{48}H_{64}O_{12} = 8C_6H_8O + O_4$. If the resin is exposed to moist air, its weight increases, and becomes constant after some weeks; if it is then exposed to dry air, the weight diminishes until it reaches a new limit. The composition at this last stage is not constant, but approximates to $C_{48}H_{64}O_{12}$. The substance formed in contact with moist air is probably a hydrate, but its composition was not determined.

In some cases, the crude resin was first placed in dry air, then before the loss of weight was complete, in moist air, and finally in dry air again. After this treatment, it had the composition $C_{48}H_{66}O_{13} = C_{48}H_{64}O_{12} + H_2O$, but this result was not constant. In another case, the composition was $C_{48}H_{64}O_{12}$. The change of weight which the resin undergoes shows that the increase of weight is not due to simple combination with oxygen, but there is simultaneous loss of carbon, increased weight being always less than corresponds with the increased percentage of oxygen. Either of the resins first mentioned increases in weight in moist air, but regains its original weight in dry air, the hydrate formed under the first conditions being decomposed in the dry air. Hydrates are obtained containing 2, 3, 5, or 7 mols. H_2O.

The resin was placed alternately several times in dry air and in air saturated with the vapor from a saturated solution of sodium chloride. The dry substance had the composition $C_{48}H_{68}O_{14}$. In the moist atmosphere, there is an increase in the percentage of oxygen, but a decrease in the percentage of carbon, which may be due either to formation of a hydrate or to oxidation with simultaneous loss of carbon.

From these results it follows that crude aldehyde resin loses water, and forms the compound $C_{48}H_{64}O_{12}$ or $8\,(C_6H_8O) + O_2$, which may be regarded as an oxidized polymeride of trialdane. This substance yields more highly oxidized products which may be regarded as hydrated oxides of the same aldane. Members of the latter series absorb water from a moist atmosphere, and form hydrates which decompose in dry air. When aldehyde resin is gradually heated from 120° to the boiling point of sulphur, it undergoes condensation. Water and an oily liquor are given off, and a non-volatile residue containing a high percentage of carbon is left in the retort.

CHLORACETONES.[1]

By C. Cloez.

The author has prepared and examined all the chlorine derivatives of acetone which are theoretically possible if the generally accepted formula is correct. A short history of the derivatives previously known is given, together with full bibliographical references.

The material employed was commercial acetone purified by fractionation and conversion into the hydrogen sodium sulphite compound. The author investigated the action of chlorine: (1) on cold acetone; (2) on acetone which at first was cold, but afterwards was heated to 100°; (3) on well-cooled acetone containing iodine; and (4) on boiling acetone containing iodine. No advantage is gained by the presence of iodine, and in fact the iodo-products which are formed in small quantity decompose during distillation and render purification very difficult. The iodine cannot be removed by means of iron or mercury. All fractions boiling above 125–130° should be distilled under reduced pressure. The final product in all four cases is tetrachloracetone.

Monochloracetone is most readily prepared by Barbaglia's method (*Ber.*, vii, 467) of passing chlorine into well-cooled acetone for several days; a current of water is sufficient for this purpose, a freezing mixture is not necessary. It boils at 117–118°; sp. gr. at 13° = 1·158. It is very slightly soluble in water, but dissolves in all proportions in alcohol, ether, and chloroform. It does not form a crystalline hydrate. and volatilizes readily in water-vapor. When freshly prepared, it has no irritating odor, but after exposure to air for some days it gives off irritating vapors. It can, however, be purified by washing with a very dilute solution of an alkali.

Monochloracetone is readily attacked by chlorine in the cold. Bromine has little effect in the cold, but at 100° energetic reaction takes place with formation of chlorotribromacetone. With potassium, it forms potassium chloride, together with red and brown products which probably contain the acetyl carbinol obtained by Emmerling by the action of potassium or potassium carbonate on bromacetone. Ammonia produces ammonium chloride and the amido-derivative, $COMe{\cdot}CH_2{\cdot}$-

[1] *Ann. Chim. Phys.* [6], ix, 145–221. Reprinted from *Jour. Chem. Soc.*, 1887, p. 1091–1099.

NH_2, which when distilled with potash yields methylamine. It follows that monochloracetone has the constitution $COMe{\cdot}CH_2Cl$.

The action of a warm concentrated solution of potash on dichlorhydrin yields a liquid closely resembling monochloracetone in its physical properties. It boils at 118–119°; sp. gr. at 11° = 1·194. It combines with hydrochloric and acetic acids, forming derivatives of glycerol, and it also combines with water. With alcoholic ammonia, it yields the badly defined compound hemichlorhydramine, $C_3H_{12}ClNO_2$; this is evidently not an acetone-derivative, and it most probably has the constitution $CH_2Cl{\cdot}CH<^{CH_2}_{-O-}>$.

Dichloracetone is best prepared by the prolonged action of chlorine on well-cooled acetone. It boils at 120°, whilst the monochloro-derivative boils at 117°, but the two compounds may be separated by taking advantage of the fact observed by Mulder and by Barbaglia, that the product obtained under these conditions has the composition of the dichloracetone even in the fraction boiling at 170°. The fraction boiling at 125–170° is collected separately and purified by further fractionation. The pure compound boils at 120°; sp. gr. at 15° = 1·234. It combines readily with sodium hydrogen sulphite, and the compound crystallizes with 3 mols. H_2O. Even when carefully purified, the vapor acts energetically on the eyes, etc., but after some time the organs become insensitive to its action. Ammonia acts rapidly on dichloracetone, with formation of ammonium chloride and the base $COMe{\cdot}CHCl{\cdot}NH_2$, which yields methylamine when distilled with potash.

The product of the action of chlorine on cooled acetone has the composition of the dichloro-derivative even in the fraction boiling at 170°, but on redistillation the boiling point is reduced to 120°. Barbaglia obtained a liquid which boiled at 165—170°, and when cooled solidified to a mass of bulky, prismatic crystals melting at 44°. In its physical properties, this product resembles symmetrical dichloracetone, but with bromine it yields a dichlorodibromacetone identical with that obtained from unsymmetrical dichloracetone, and very different from the corresponding compound obtained from the symmetrical derivative. This high boiling fraction may be a polymeride.

Symmetrical dichloracetone is obtained by the action of silver chloride on the symmetrical diiodoacetone prepared by the action of iodine chloride on acetone in presence of water. It has a pungent

odor, forms crystals which melt at 44°, and boils at 170° without decomposition.

When dichlorhydrin is oxidized by means of a well-cooled mixture of sulphuric acid and potassium dichromate, in the manner described by Grimaux and Adam, it yields a liquid which has the composition of dichloracetone. When this product is cooled, it crystallizes in large needles melting at 43—44°, which change spontaneously, especially in presence of ether, into short prisms with the same melting point. It boils at 170°, has a very pungent odor, and in ethereal or alcoholic solution is a most powerful caustic, producing very severe burns. With ammonia, it forms an unstable compound which crystallizes in large plates.

In diffused daylight, chlorine acts somewhat slowly on epichlorhydrin. When the product is distilled and the fraction boiling at 160—180° is purified, it yields a liquid which boils at 170° and has the composition $CHCl_2 \cdot CH < \begin{matrix} CH_2 \\ O \end{matrix} >$, and is therefore an isomeride of dichloracetone. With ammonia at a low temperature, it yields a white, amorphous, unstable substance, almost insoluble in water, alcohol, and ether; this has the formula $C_6H_4Cl_2NO_2$, but its constitution could not be determined.

The dichloracetone obtained from diiodoacetone is not identical with the so-called symmetrical dichloracetone obtained by the oxidation of dichlorhydrin. The action of bromine, potash, or oxidising agents on dichlorhydrin yields derivatives which closely resemble derivatives of the acetones, but are never identical with them. Potash yields epichlorhydrin, which closely resembles monochloracetone in its physical properties. Bromine yields a derivative to which the constitution $CO(CHClBr)_2$ has been assigned. A compound, $CHCl_2 \cdot CO \cdot CHBr_2$, can also be obtained from acetone. If the two compounds are treated with mercuric chloride the latter yields tetrachloracetone, whilst the former yields a compound containing a lower percentage of chlorine.

If ordinary dichloracetone and the symmetrical dichloracetone from the iodo-derivative are treated with bromine, they both yield dichlorodibromacetones, and when the latter are treated with mercuric chloride the same symmetrical tetrachloracetone is obtained in both cases. When the pseudodichloracetone from dichlorhydrin is treated in the same way, the product is an isomeride of tetrachloracetone, very dis-

tinct from either of the compounds $CO(CHCl_2)_2$ and $CCl_3{\cdot}CO{\cdot}CHCl$. Since only two tetrachloracetones can exist, it follows that the derivative from dichlorhydrin is not an acetone-derivative. Again, when dichloracetone and the pseudodichloracetone are subjected to the action of chlorine in sunlight, the products are very different, although both have the composition of pentachloracetone. Only one pentachloracetone is, however, possible. The pseudodichloracetone is a derivative of dichlorhydrin, $CH_2Cl{\cdot}CH(OH){\cdot}CH_2Cl$, and has the constitution $CH_2Cl{\cdot}CH<_{-O-}^{CHCl}>$, analogous to that of epichlorhydrin. Pseudodichlorhydrin does not combine with acetic acid. It reacts violently with concentrated hydrochloric acid, but when the product is evaporated over sulphuric acid the original compound is obtained.

Trichloracetones.—When a limited quantity of bromine is allowed to act on dichloracetone, the product $CHCl_2{\cdot}CO{\cdot}CH_2Br$ is obtained, which boils at 111° under a pressure of 25 mm., and when this is heated with mercuric chloride in presence of alcohol, trichloracetone boiling at 172° is obtained. This trichloracetone yields no chloroform with aqueous or alcoholic ammonia, and no phenylcarbylamine with aniline and potash. It therefore does not contain the group CCl_3, and must have the constitution $CHCl_2{\cdot}CO{\cdot}CH_2Cl$. Only a very small quantity was obtained.

Trichloracetone, $CCl_3{\cdot}CO\,CH_3$, is readily obtained by the action of chlorine on an aqueous solution of sodium citraconate heated at 100° (Gottlieb and Morawsky, *J. pr. Chem.* [2], xii, 369). With ammonia, it yields chloroform and a small quantity of ammonium chloride, together with a large quantity of acetamide if the liquid has been kept cool and excess of ammonia has been avoided.

The action of chlorine on impure methyl alcohol (Bouis) or on acetone (Bischoff) yields a liquid which has the composition of trichloracetone and boils at 172°; sp. gr. 1·418. It solidifies incompletely in long needles at —14°, the temperature rising suddenly to —5°. The crystals melt between —5° and +2°. It combines with 2 mols. H_2O, forming a hydrate which melts at 43—44°. It also combines with sodium hydrogen sulphite, but the product crystallizes with great difficulty. With aniline and potash, it yields phenylcarbylamine; but with ammonia it yields very little, if any, chloroform or acetamide, ammonium chloride, however, is formed in large quantities, and if the liquid is distilled with potash, it yields dichloromethyla-

mine, which is doubtless derived from the compound $CHCl_2 \cdot CO \cdot CH_2 \cdot NH_2$. It would follow that the trichloracetone has the constitution $CHCl_2 \cdot CO \cdot CH_2Cl$, but the formation of chloroform and phenylcarbylamine, and the variable boiling and melting points of the compound, show clearly that it is a mixture of a solid trichloro-derivative which melts about —5°, with an isomeride which is liquid even at low temperatures.

Unsymmetrical tetrachloracetone was obtained by Bouis by the action of chlorine on wood-spirit in diffused daylight (*Ann. Chim. Phys.* [3], 21—111), and by Bischoff by the action of chlorine on a mixture of acetone and methyl alcohol (1876). It is most readily obtained by passing chlorine into commercial acetone, the temperature being allowed to rise. Tetrachloracetone is a colorless liquid which boils at 180°—182°, and becomes brown when exposed to air and light; sp. gr. at 17°=1·482. When distilled under the ordinary pressure, it undergoes partial decomposition. It is very hygroscopic, and forms a tetrahydrate which melts without decomposition at 30°. With aniline and potash it yields phenylcarbylamine, and with aqueous ammonia at a low temperature it yields chloroform and monochloracetamide. It therefore has the constitution $CCl_3 \cdot CO \cdot CH_2Cl$.

By the prolonged action of chlorine on pure acetone at first cooled and afterwards heated on a water-bath, Grabowsky (1876) has obtained trichloromethyl propyl ketone, boiling at 186°. The author has been unable to obtain this result. Probably the nature of the reaction depends on the purity of the acetone.

Symmetrical tetrachloracetone.—Dichlorodibromacetone prepared by the action of bromine on unsymmetrical dichloracetone is heated with alcohol and mercuric chloride in sealed tubes at 100°. The product is distilled, and is purified from mercury by conversion into a hydrate which is repeatedly recrystallized, and then decomposed by hydrochloric acid. The product is dried over calcium chloride, and boils at 179°—181°; its sp. gr. is the same as that of the preceding compound. With water, it forms a hydrate crystallizing in needles which melt at 47°—48°. With ammonia or aniline, it yields no distinct result, but neither chloroform nor phenylcarbylamine is formed. The compound therefore does not contain the group CCl_3, and must have the constitution $CHCl_2 \cdot CO \cdot CHCl_2$.

The dichlorodibrom-derivative obtained by the action of bromine on dichlorhydrin yields with mercuric chloride an oily liquid which

has no fixed boiling point, and is not attacked by ammonia at the ordinary temperature. It is not a tetrachloracetone.

When the product of the oxidation of dichlorhydrin is treated with bromine, it yields an isomeride of dichlorodibromacetone, which, according to Markownikoff, has the constitution $CHClBr{\cdot}CO{\cdot}CHClBr$. When this compound is treated with mercuric chloride, however, it yields a liquid which fumes in the air, boils at about 180°, has a disagreeable odor, and does not combine with alkaline hydrogen sulphites. With ammonia or aniline, it yields neither chloroform nor phenylcarbylamine, but dichloracetamide and dichloracetanilide respectively. It follows that either there are two isomeric symmetrical tetrachloracetones, or that the product of the oxidation of dichlorhydrin is not an acetone derivative, as already indicated.

When symmetrical iodacetone is treated with silver chloride, and the product is treated with bromine and afterwards with mercuric chloride, a liquid is obtained which boils at 180°, and is identical with symmetrical tetrachloracetone. The dichloracetone from iodacetone has always been regarded as identical with Markownikoff's products, but these results show that they are very different, and the latter is most probably a derivative of epichlorhydrin—

$$CH_2Cl{\cdot}CH<\begin{matrix}-O-\\ CHCl\end{matrix}>.$$

Pentachloracetone was obtained by Staedeler by adding hydrochloric acid to a boiling solution of quinic acid and potassium chlorate. The yield is very small, and great care is required to avoid explosions. Much better results are obtained by the following method. A solution of citric acid in 1·5 parts of water is allowed to fall drop by drop down a tube packed with pumice, up which passes a current of dry chlorine, the tube being heated at 100° by means of a water-jacket. The product is purified by washing and redistillation. If the water used for washing is evaporated at a low temperature, it deposits crystals of citric acid which contain 2 mols. H_2O, and are quite different in appearance from the ordinary crystals. They form flattened prisms with four of the faces abnormally developed. The cleavage planes and the angles at the edges are, however, identical with those of the ordinary crystals.

The pentachloracetone obtained is identical with that prepared by Staedeler and by Cloez, sen., by the action of chlorine on alkaline citrates. With ammonia, it yields chloroform and dichloracetamide,

and with aniline it yields phenylcarbylamine and dichloracetanilide. It may also be prepared in large quantity by the action of dry chlorine on dry commercial acetone in direct sunlight. Pure acetone seems to give a different result, since Fittig, and Dumas and Kane, obtained no derivative higher than the dichloracetone by the action of chlorine on acetone at 100° or in sunlight. Under the conditions given, however, the acetone is converted into a mixture of pentachloracetone and hexachloracetone which are separated by fractionation.

Pentachloracetone is a colorless liquid with an odour resembling that of chloral, which, however, is only observed after the liquid has been exposed to air. It boils at 192°, and is readily volatile in water vapor; sp. gr. at 14° =1·576. It dissolves in 10 parts of water, from which it separates completely at 50—60°. At low temperatures, the solution deposits a tetrahydrate in small, rhomboidal plates melting at 15° with decomposition. With ammonia, it yields chloroform and dichloracetamide.

The action of chlorine in sunlight on the pseudodichloracetone from dichlorhydrin yields a liquid which has a pungent smell, and boils at 185°; sp. gr. at 8° =1·617. With ammonia, it yields trichloracetamide but no chloroform, and hence it is not a derivative of acetone. The action of chlorine on dichloropropylene oxide yields a strongly fuming liquid which boils at about 178°. Its composition does not agree very well with that of pentachloropropylene oxide, and when treated with ammonia, it yields trichloracetamide but no chloroform. It therefore has the constitution $CHCl_2 \cdot CCl{<}^{CCl_2}_{-O-}{>}$. From these results, it is evident that there are three isomeric compounds having the composition of pentachloracetone, but only one of these is really a derivative of acetone.

Hexachloracetone was obtained by Plantamour by the action of chlorine on a solution of citric acid in sunlight, and has been described under different names by Laurent, Staedeler, and Cloez, sen. A solution of citric acid is treated with chlorine in sunlight until the gas is no longer absorbed. Carbon dioxide is given off, especially in the later stages of the reaction. The yield is about one-fourth of the weight of the citric acid taken. Hexachloracetone can readily be obtained by the action of chlorine on acetone in sunlight. The fraction of the product which boils at 185—220° is collected and purified.

The fraction boiling at 290° contains a considerable quantity of hexachlorobenzene, which is probably formed by pyrogenic decomposition, and does not exist in the product before distillation. It is not always formed.

Hexachloracetone is a very limpid liquid with an odor which is feeble at a low temperature, but becomes very pungent and irritating when the liquid is warmed. It boils without decomposition at 202—204°, and when cooled solidifies in large, white plates melting at —2°; sp. gr. at 12°=1·744; vapor density 9·615. It is slightly soluble in water, and forms a crystalline monohydrate which is almost insoluble in water. With aqueous ammonia, it yields chloroform and trichloracetamide, and with aniline it yields chloroform and trichloracetanilide. When heated with water in sealed tubes at 120°, it splits up into chloroform and trichloracetic acid. The action of chlorine on epichlorhydrin in sunlight yields crystals which seem to be hexachlorobenzene, and a small quantity of a liquid which boils at 200—210° and yields chloroform and trichloracetamide with ammonia. Most probably the product has the constitution $CCl_3 \cdot CCl<\begin{matrix}CCl_2\\-O-\end{matrix}>$.

Chlorobromacetones.—Theegarten treated epichlorhydrin with bromine, and oxidized the product. In this way, he obtained crystals which have an irritating odor, melt at 34—35°, and boil at 177—180°. This compound is only slightly soluble in water, but dissolves readily in alcohol and ether. It does not combine with bisulphites, and doubtless has the constitution

$$CH_2Cl \cdot CH<\begin{matrix}CHBr\\-O-\end{matrix}>$$

A compound with the composition of monochlorotribromacetone was obtained by Claus and Lindhorst (1880) by the action of bromine and water on dichlorhydrin, and by Grimaux and Adam by the action of bromine on epichlorhydrin at 100°. With equal molecular proportions of bromine and epichlorhydrin, the reaction is complete in a few hours. The product is a colorless, pungent liquid, heavier than water, with which it forms a hydrate melting at 55°, soluble in alcohol, and stable when exposed to air. The compound itself decomposes when boiled even under reduced pressure. It is not a true derivative of acetone, but is derived from epichlorhydrin.

When monochloracetone is heated with bromine at 100° and the

product dissolved in water, a tetrahydrate is formed which can be recrystallized. It is decomposed by hydrochloric acid, and when the liquid thus obtained is dried, it boils at 130° under a pressure of 25 mm., and at 215° under normal pressure; sp. gr.=2·270. It has a pungent, irritatiag odor. The hydrate is only slightly soluble in water, but dissolves more readily in alcohol of 80°, from which it crystallizes in large, hexagonal tables containing 1 mol. H_2O; this is readily given off even on exposure to the air. With aqueous ammonia at a low temperature, chlorotribromacetone yields bromoform and chloracetamide, and therefore has the constitution $CBr_3{\cdot}CO{\cdot}CH_2Cl$. So-called dichlorodibromacetone, obtained by the action of bromine on pseudodichloracetone, is a liquid which solidifies at —14°, melts at —8°, and boils at 135° under a pressure of 40 mm. It does not combine with alkaline hydrogen sulphites. It forms a tetrahydrate, which crystallizes in long prisms melting at 53—54° with partial decomposition. The action of ammonia shows that this compound contains neither CCl_2Br nor CBr_2Cl, and hence its constitution must be

$$CHBrCl{\cdot}CH<\begin{matrix}CBrCl\\ -O-\end{matrix}>.$$

The action of bromine on dichlorhydrin yields a compound which boils at 140—141° under a pressure of 20 mm. It forms a crystalline tetrahydrate which melts at 55—56°, and boils with partial decomposition at 140—150° under a pressure of 20 mm. It is not identical with the preceding compound, and may have the constitution

$$CBr_2Cl{\cdot}CH<\begin{matrix}CHCl\\ -O-\end{matrix}>.$$

The action of bromine on ordinary dichloracetone yields a liquid which boils at 120° under a pressure of 25 mm., and does not solidify at a low temperature. It forms a tetrahydrate which crystallizes in hexagonal tables with a very disagreeable odor; these readily lose their water. Barbaglia's dichloracetone boiling at 170° yields the same derivative with bromine, and is therefore a polymeride of ordinary dichloracetone. Dibromodichloracetone reacts energetically with ammonia, but no chlorobromoform is produced, and hence the compound must have the constitution $CHCl_2{\cdot}CO{\cdot}CHBr_2$. With mercuric chloride, it yields a tetrachloracetamide which does not contain the group CCl_3.

When trichloracetone is treated with bromine at 100°, it yields a trichlorobromacetone, which boils at 107° under a pressure of 25 mm.,

and at 190° under the ordinary pressure. It is very hygroscopic, and forms a tetrahydrate which crystallizes in hexagonal tables melting at 48°. With ammonia, it yields chloroform and bromacetamide, and therefore must have the constitution $CCl_3 \cdot CO \cdot CH_2Br$.

Tetrabromacetone forms a tetrahydrate, which, although unstable, crystallizes readily. With ammonia, it yields bromoform and bromacetamide.

All the chlorobromacetones described are tetra-substitution-derivatives. Starting from tetrachloracetone, each substitution of bromine for chlorine produces a rise of about 10° in the boiling point. There is also a gradual increase in the specific gravity.

Action of Ammonia and Amines on Chloracetones.—The action of orthotoluidine on hexachloracetone yields orthocresyltrichloracetamide, $C_6H_4Me \cdot NH \cdot C_2Cl_3O$, which crystallizes in large needles only slightly soluble in cold alcohol. It melts at 66—67°, readily remains in superfusion, and volatilizes at 215°. Paratoluidine yields the corresponding para-derivative, which crystallizes in very short rectangular prisms, melting at 79—80°, and volatilizing with partial decomposition at 185°. It is only slightly soluble in cold alcohol.

With diethylamine, hexachloracetone yields diethyltrichloracetamide, which is very soluble in alcohol, and crystallizes in prisms which melt at 90° and volatilize almost immediately with partial decomposition. With trimethylamine, dimethyltrichloracetamide is formed; this is very soluble in boiling alcohol, and crystallizes in radiating needles which melt at 104°, and sublime at 195°. With dimethylaniline, the reaction takes place only on warming, and the product is a mixture of a violet coloring matter, soluble in boiling water but almost insoluble in ether, and very soluble in chloroform, with another badly defined coloring matter. Allylamine yields allyltrichloracetamide, soluble in alcohol and in chloroform, and crystallizing in large tables which melt at 45° and volatilize without decomposition at 190°. With hexachloracetone and pentachloracetone respectively, ethylenediamine yields the two derivatives, $C_2H_4 : N_2H_3 \cdot C_2Cl_3O$ and $C_2H_4 : N_2H_3 \cdot C_2HCl_2O$. The first is soluble in alcohol, and crystallizes in elongated rhomboidal plates which melt at 200° and sublime at the same temperature. The second is soluble in warm alcohol, and very soluble in ether. It crystallizes from alcohol in elongated parallelograms, and from ether in fan-shaped plates.

When one molecular proportion of urea is heated at 150° with two molecular proportions of hexachloracetone, the amide—

$$CO:N_2H_2(C_2Cl_3O)_2,$$

is readily obtained. It crystallizes from its alcoholic solution in yellowish, hexagonal plates.

CONTRIBUTION TO THE KNOWLEDGE OF THE COCA BASES.[1]

By O. Hesse.

Almost simultaneously with the publication of my note on the alkaloids of coca leaves in the *Pharmaceutische Zeitung*, appeared a communication from W. C. Howard,[2] in which that chemist referred to the alleged non-existence of "amorphous cocaine," and at the same time gave a brief description of a base that he considered to be hygrine, though it was obviously nothing else than the "amorphous cocaine" in question, but probably in a state of incomplete purification. Howard separated this base from cocaine by means of the corresponding platino-chloride, which he treated with a large quantity of water at a temperature of 80° C., and thus dissolved out the cocaine salt from the assumed hygrine salt, which remained undissolved. The base obtained from this salt was not entirely free from smell; it had an intensely bitter taste, formed an amorphous hydrochlorate, and the platinochloride contained from 18·48 to 18·6 per cent. of platinum. Howard is of opinion that this base contains three atoms of carbon more than cocaine, but he does not furnish any data to show that a carbon determination was made, and appears rather to have based that opinion upon the result of the platinum determination, overlooking the fact that this platinum salt contains about 5 per cent. of water. Probably this error has arisen from the circumstances that the air-dried cocaine platinochloride, being anhydrous, contains under the same conditions an amount of platinum corresponding to the formula—

$$(C_{17}H_{21}NO_4)_2PtCl_6H_2.$$

Howard found that the amount of platinum in the platinochloride of this so-called hygrine, which was undoubtedly a hydrated salt, was

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[1] From the *Pharmaceutische Zeitung*, Nov. 23, reprinted from *Phar. Jour. and Trans.*, Nov. 26, 1887.

[2] *Pharmaceutical Journal*, [3], vol. xviii., p. 71. *Amer. Jour. Phar.*, 1887, p. 453.

the same as that previously found by me in the same salt prepared from the amorphous portion of the coca bases.

	Howard.		Hesse.	
Pl.....	18·48	18·6	18·26	18·44
H_2O.....	not determined.*		5·00	5·50

From these data alone it might be inferred that Howard's so-called hygrine was identical with the amorphous portion of the coca bases which I had prepared. So, likewise, the cocainoidine of Lyons and the cocaicine of Bender are in all probability in the main the same substance.

Since that time I have been engaged in the endeavor to prepare in a pure state the base of which these several products may consist to a greater or less extent, and by making use of broad-leaved coca I have succeeded in doing so without difficulty. After having with this object entirely separated the cocaine as hydrochlorate from the mixture of bases by a special process, the residual mixture, which was ascertained to be free from cocamine, was dissolved with dilute hydrochloric acid, and the solution mixed with ammonia in excess. The precipitate thus produced was separated from the mother-liquor and again dissolved with dilute hydrochloric acid and precipitated with ammonia, this operation being repeated until a portion of the precipitate gave with acids a solution which no longer showed any fluorescence when diluted with water, and was therefore quite free from actual hygrine.

The alkaloid thus purified was further washed with water at a temperature of 80° C., and was thus reduced to a melted mass, that was spread out upon glass plates and dried thoroughly at 60° C. In that condition when cold it could be detached in the form of transparent brittle laminæ, yielding a white powder that melted at about 51° C. In such a purified condition I call this alkaloid "cocaidine." Its composition is represented by the formula $C_{17}H_{21}NO_4$, yielding on analysis 67·2 per cent. carbon and 7·01 hydrogen, and it is therefore isomeric with cocaine and cocamine. It dissolves readily in ether, alcohol, acetone, chloroform, petroleum spirit, or benzene, but scarcely at all in water, ammonia solution, or caustic soda; it has an alkaline reaction, but does not alter phenolphthalein. At first it appears to be tasteless, but gradually develops, after a rapidly disappearing sense of numbness in the tongue, a bitter taste. A chloroform solution gives in the polariscope with p=4 and t=20° C. $(\alpha)_D = -20·6$, so that it

turns the plane of polarized light rather more strongly to the left than cocaine does.

Cocaidine, when perfectly dried, attracts water from the atmosphere and then cakes together. It is free from odor and does not volatilize with water vapor. When boiled with an alcoholic solution of baryta it splits up, yielding benzoic acid, but what other product is then formed has not yet been ascertained.

Cocaidine hydrochlorate has the form of an almost colorless varnish, readily soluble in water or alcohol, and but slightly hygroscopic. It is without smell, tastes intensely bitter, and does not appear to produce irritation of the mucous membrane. The platinochloride has a composition represented by the formula—

$$(C_{17}H_{21}NO_4)PtCl_6H_2+3H_2O.$$

As regards hygrine, the statements of Lossen in reference to it are somewhat ambiguous, inasmuch as it appears that in part they apply to the substance obtained directly from the coca leaves that would have still contained cocaidine, and in part, also, to the product obtained from it by distillation with water. So much, however, is certain, that hygrine is a liquid as the name indicates, and that it is capable of being distilled with water vapor.

Since cocaine, cocaidine and cocamine are neither of them volatilizable when boiled with water, nor capable of yielding volatile bases by such treatment, these circumstances would point to a possible mode by which hygrine could be obtained if it were present. My observations in this respect are in complete accord with those of Stockman and Howard, according to whom the "crude amorphous cocaine" yields, when subjected to distillation with water, small quantities of an oily basic substance. The mother-liquor obtained as a bye-product in the purification of cocaidine is the most suitable source from which this oily base may be prepared. This liquid is mixed with some caustic soda and shaken out with ether, the ether solution evaporated, and the residue distilled with water to drive over the hygrine. The distillate is mixed with hydrochloric acid in slight excess, evaporated to dryness, and the hygrine separated from the residue by shaking with caustic soda and ether. The brown oily residue obtained on evaporating the ether is treated with dilute acetic acid, which separates a dark brown smeary mass, and the perfectly clear filtered solution is mixed with excess of caustic soda and shaken out with ether.

The hygrine left on evaporating the ether solution obtained in the

last operation is a yellowish oily substance of peculiar odor, somewhat suggestive of that of chinoline; it has a strong alkaline reaction upon red litmus paper, does not alter phenolphthalein, has a slight burning taste, dissolves readily in ether, chloroform, or alcohol, but little in water or caustic soda solution, and forms a crystallizable salt with hydrochloric acid. A water solution of the hydrochlorate becomes milky on addition of caustic soda, owing to the separation of the base in minute oily globules which aggregate after a time. The base forms with oxalic acid a salt crystallizing in small needles. The platinum salt is also crystallizable.

The fluorescence of solutions of hygrine in dilute acid is a marked character, but it becomes apparent only on dilution with water, and is not recognizable when the solutions are concentrated. The fluorescence is also destroyed by other substances, such, for instance, as sodium chloride.

Hygrine volatilizes with water vapor, and at a higher temperature it may be distilled alone. The quantity at my disposal was too small to admit of a determination of the precise boiling point. To ascertain the composition of the base the platinum salt was analyzed and found to give—

						Calculated.
Pt	24·51	25·02	24·25	2·25	24·18	24·71
C	—	36.59	—	—	36·80	36·59
H	—	4·05	—	—	3·94	3·55
Water of crystallization	4·73	4·51	4·35	5·15	—	4·57

These data lead to the formula $(C_{12}H_{13}N)_2PtCl_6H_2+2H_2O$, and show that hygrine is a homologue of chinoline, C_9H_7N, having the same composition as tetrahirolene of Greville Williams, but whether or not it be identical with that substance must be left for further inquiry to determine.

Wöhler and Lossen state that the substance to which they gave the name of hygrine had a distinct smell of trimethylamine, and several other observers have repeatedly remarked the odor of that base in the preparation of cocaine. It is therefore very possible that hygrine may be really trimethylchinoline, and that this base is convertible under certain conditions into trimethylamine and a non-nitrogenous substance, as is the case for example with dimethylpiperidine methylhydroxide. This, however, is only a speculation that must be submitted to the test of experiment.

AUSTRALIAN OPIUM.

By W. E. Matthews.

The greater part of the colonial opium found in the Melbourne drug market comes from the Bacchus Marsh district, where the cultivation of the poppy has been carried on for the past eighteen or twenty years. The first supply of opium sent into the market from this district was in 1871, and scarcely a season has been missed since. Through the favor of Messrs. Pearce Bros., of Bacchus Marsh, Mr. Thomas Doubleday, of Coimadai, who is the largest grower in the colony, has kindly supplied many interesting notes on the culture of the poppy and collection of the opium. The light loamy flats on river banks are most suited to the growth of the poppy, and it has been found advisable to sow at three distinct periods. About the first week in May, the second or third week in June, and the latter end of July are the best seasons for the purpose. By adopting this system of sowing the whole crop comes into readiness in rotation, and is consequently more easily managed.

Mr. Doubleday sows the seed in drills about twenty-two inches apart and half an inch deep. When the plants are two or three inches in height, cleaning and thinning is commenced, leaving the plants ten inches apart, giving from 28,000 to 29,000 plants to the acre, which, in an average crop, yields about 150,000 capsules; and as each capsule receives at least four incisions, and each incision has to be scraped once, a slight estimate may be formed as to the labor attached to an acre only. In moderately moist seasons the plants attain the height of seven feet and over, but this is no advantage to the grower, as it has been noticed by Mr. Doubleday that it not only renders the crop somewhat unmanageable, but also reduces the yield of opium. A crop averaging from three to five feet is by far the most productive and easily managed. An acre, in a good season, will yield from thirty to forty pounds of marketable opium, but from fifteen to twenty-five pounds is about the average product per acre in the Bacchus Marsh district, over thirty pounds being considered exceptionally good. The average yield on the Continent is twenty-five pounds; in India, in a good season, the yield is from thirty to forty pounds per acre. About four days after the flower opens the petals fall, and in another four days after (the time depending mainly on the state of weather) the capsule changes to a bluish-green. It is then sufficiently mature for

scarification. Two horizontal incisions are made, extending across one-half of the circumference. This is done in the evening, and the thin, milky juice (opium) that exudes during the night is scraped off early on the following morning, so as to finish gathering before the opium becomes hardened by the sun. Cold, showery weather is much against the grower, as the exuding juice, being thin, is easily washed off. Hot days and heavy dews at night increase the flow, and improve the consistency of the product. Two days after the first scarification the capsule is ready for incisions to be made on the opposite side. This is sometimes repeated till the capsule is thoroughly exhausted. The opium, when gathered, is made into balls from about half a pound to a pound in weight. These are dried in the shade, care being taken to turn them every second day to prevent mould, the length of time between the turnings being increased as the opium hardens.

A sample of that collected last season at Bacchus Marsh, assayed in accordance with the *British Pharmacopœia*, yielded 11.5 per cent. of morphine in the dry powdered opium. A small sample from Queensland gave 9·8 per cent. of morphine by the same process. An analysis of the Bacchus Marsh opium gave the following results:—morphine, 10·65; codeia, .55; narcotina, 6·48; narceine, 6·11; gummy matter, 26·70; mucus, 21·62; resin and oily matters, 6·80; water, 9·19; undetermined and loss, 11·90; total, 100·00. A batch of extractum opii, prepared from one pound of colonial opium, yielded a product of 9·3 ounces of a good extract of full alkaloidal strength.—*Austral. Jour. Pharm.*, Nov., 1887, p. 393.

RECENT RESEARCHES IN BOTANY.[1]

By E. G. Baker, F.L.S.

The state of botanical research in this country at the present time is in a decidedly encouraging condition. For a long time English botanists have taken a leading part in systematic botany; but in histological and physiological botany there has been a great lack of original work. Now it seems likely that this will be changed. A new school has arisen, and at the leading universities a regular course of practical work is annually given. Some

[1] Read at a meeting of the Chemists' Assistants' Association, October 20. Reprinted from *Phar. Jour. and Trans.*, November 5, 1887.

of you may have noticed as evidence of this activity the numerous works recently published.

An excellent work on practical botany by Bower and Vines will be found all that can be desired for laboratory work, while students of three or four years ago will remember having to rely on Sachs' "Botany" as an advanced text-book. The different parts which compose this work are now published separately with much amplification by the Clarendon Press, Oxford.

Only last month a new journal called *Annals of Botany* first saw the light, showing that the present publications were inadequate to meet the demand. It specially deals with physiological, morphological and histological botany, and the papers are copiously illustrated.

In saying a few words, then, on "Recent Researches in Botany," the difficulty is not want of material, but rather the reverse. I have endeavored, therefore, only to select such matter as may be of general interest.

First of all I would refer to some "Notes and Queries on Gentians," by Professor Huxley. It may, perhaps, surprise you to find Professor Huxley writing a botanical paper, but he has written a very valuable and interesting one, and which is well worth a little attention.

Having to spend some six weeks in Switzerland during August of last year, he was much attracted by the Alpine vegetation, and especially by the gentians; so much so, that not only did he examine the few species that grow wild there, but on returning home he devoted himself to a complete review of the whole natural order Gentianaceæ. At the time he was in Switzerland two species were principally in flower, and I was much struck by a statement he made, which was that if he gathered two or three specimens he found no difficulty in giving their names, but that if he gathered fifty, so great was their variation, that it was almost impossible to state definitely where one species began and the other ended. This I find to be one of the chief difficulties in systematic botany. In a great many natural orders the descriptions of the various species have to be drawn up so as to allow of a certain range of variation, and even then if you have a good supply of specimens you are nearly sure to find some one or two that act as connecting links between the species.

Professor Huxley has done for the gentians what he and other Darwinian zoölogists have done for many groups ef animals. He has worked at them and endeavored to trace their relationship to one another, and to see how far they can be made to conform to one common type, just as he showed in a well-known paper that the horse, ass and zebra were all descended from a single common miocene ancestor.

After examining the flowers of a large number of the Gentianaceæ he found that nectaries were present, and that the nectarial surface was sometimes situated on the corolla and sometimes at the base of the ovary. This then formed the main point in his system of classification.

The natural order Gentianaceæ is well suited to a critical examination of this character, as it is a well-marked one, and its limits are fairly well defined. Arranging, on the one hand, the flowers of this natural order having nectaries on the corolla, and on the other those having nectaries at

the base of the ovary, Professor Huxley pointed out the lines along which the probable evolution of the Gentianaceæ have taken place, and also sketched a hypothetical ancestor.

It is interesting to note that this arrangement, which I think I may call a biological arrangement, differs materially from the ordinary arrangement, such as given, for instance, in Hooker and Bentham's "Genera Plantarum."

Passing now from a consideration of the structure of the "gentians," I would turn your attention to a certain abnormal phenomenon in the life history of a fern known as "apospory," whereby the usual life cycle is shortened. Professor Bower has shown that in the case of *Athyrium Filix-fœmina* var. *clarissima*, Jones, complete sporal arrest occasionally takes place: the sporangia instead of developing spores develop into prothalli. In *Polystichum angulare* var. *pulcherrimum*, Padley, this phenomenon also takes place, and, furthermore, prothalli have been observed to develop from points on the frond away from the sori—in this case, then, the sporangium is also eliminated.

The phenomenon of apospory may be considered as a mere sport, but certainly a peculiar one, interfering, as it does, to such a large extent in the life history of the plant concerned.

A good deal of attention has lately been paid to the effect various chemicals have in stimulating and retarding growth in plant life.

At the recent meeting of the British Association in Manchester, Dr. Vines mentioned some experiments he had been making with the two alkaloids, atropine and physostigmine. Everybody here doubtless is acquainted with the action of these two bodies when used in eye operations, the one dilating the pupil of the eye, and the other causing contraction. They possess very marked properties—the one being exactly antagonistic to the other, so are well suited for experimentizing with. Their action was tried on the common sensitive plant (*Mimosa pudica*), and it is interesting to note that, as in the case of animal tissues, the result obtained was stimulation of the vegetable cell in the one case, and contraction in the other.

This effect of stimulating vegetable growth has been the subject of a series of experiments conducted at Cambridge by Anna Bateson and Francis Darwin. If the turgescent pith from a growing shoot is freed from the external tissues, it exhibits a sudden increase in length. It also exhibits increase in length if placed in damp air or water.

This latter fact, and the possibility of accelerating and retarding the rate of increase in length by various reagents, was made the point of a number of careful observations.

The pith, obtained either from the Jerusalem artichoke (*Helianthus tuberosus*) or sunflower (*H. annuus*), was attached to the bottom of a narrow glass jar, the upper end being connected by means of a thread of plaited silk with the short arm of an auxanometer-lever in order that any increase in length might be accurately measured.

If a strip of pith is filled up as here described and the jar is then filled with water, the elongation as exhibited by the descent of the long arm of

the lever is most striking; indeed, so rapid is its movement, that it travels in many cases over ten millimetres in one minute.

The stimulating effect of alcohol was first tried. Methylated spirit 2 per cent. being used, the acceleration was 100 : 150.[1]

The stimulating effect of ether vapor was then tried, the pith in these experiments being allowed to grow in damp air. A known quantity of ether was poured into a jar of known capacity. The mouth of the cylinder was closed by a divided glass disk which allowed the passage of the thread attaching the pith to the lever.

The atmosphere of ether was kept as constant in strength as was possible. The following table shows the percentage of ether in the atmospheres which caused acceleration, the amount of quickening being given in a parallel column.

Percentage of ether.	Acceleration of growth.
0·27°	100 : 118
0·37°	100 : 146
0·40°	100 : 200

With chloroform the results were—

Per cent.	
0·008	Retardation of growth.
0·05	No effect.
0.1	No effect.
0·9	Slow contraction.

An aqueous solution of camphor, said to be 0·1 per cent., was tried, but no effect on the "growth" of the pith was observed.

Weak solutions of ammonia were found to have a well-marked stimulating effect.

Strength of solution.	Amount of acceleration.
0·5	100 : 145
1·9	100 : 103
2·0	No effect.
2.2	100 : 121
2·4	100 : 129

Various acids were tried. As a rule they had no accelerating effect on growth, but caused either retardation or actual contraction of the pith.

Acetic acid and hydrochloric acid caused decided retardation. The effect of nitric acid was not very evident.

Carbolic acid of ·5 per cent. and 1 per cent. did not seem to have any effect, but 3 per cent. caused a contraction of the pith.

The effect of prussic acid was very striking. It did not produce a contraction, as might have been expected, but either a temporary acceleration or else a remarkably steady high rate of growth continued for a prolonged period.

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[1] One hundred represents a definite amount of acceleration, *i. e.*, increase in length at the rate of 0·46 million per minute.

The effect of quinine was tried, aqueous solutions of quinine chloride being used, ranging between ·15 per cent. and ·34 per cent.

The result was retardation, followed in a few minutes by contraction and death.

These results appear to me particularly interesting. I do not wish to comment on them further than just to draw your attention to the last two cases, where it will be remembered that while hydrocyanic acid caused acceleration the effect of quinine was contraction and death.

Before concluding, I should just like to say a few words on some of the work that takes place at Kew. Very few of those who take a casual stroll through the gardens or greenhouses have any idea of the work that is done, so to speak, behind the scenes. Kew Gardens act as a sort of nursery for any vegetable economic product that may be found. The plant is there grown and propagated, and when the time arrives distributed anywhere among our colonies where it will grow.

Thirty years ago it was cinchona that was being taken in hand—to-day it is plants like the coca plant (*Erythroxylon Coca*). The effect in the former case is apparent to all who have watched the price of quinine for the last few years; the effect in the latter case remains yet to be seen.

One of the most recent arrivals at the Gardens is a packet of *Gymnema*, the plant that is said to take away the power of taste; whether this will prove to be worth growing and propagating must also be left as yet unsettled.

There are many plants which will shortly have to be taken in hand, as the extermination of the wild stock is proceeding at a rapid rate. Foremost among these may be mentioned india-rubber. The supply of this article is obtained from uncultivated material, but this is rapidly being exhausted, and needs replenishing. It is work of this character that the authorities at Kew undertake to superintend and carry out to the best effect. Surely this judicious distribution of economic products is botanical research of a very practical kind.

Before leaving the subject of Kew Gardens, I would remind any student who may be here that there is a part of the Gardens that is now set aside specially for their benefit. Here the plants will be found arranged in beds and classified according to their natural orders, and anyone so wishing is allowed to pick and dissect the various flowers that will be found there. Whether the student's object be to do a little botanical research on his own account, or shall I say only to get up the characters of the orders for an examination, everything will be found suited to his requirements.

There are many more points that might have been discussed as being recent researches of a botanical character. The "Present Aspect of the Cell Question" affords material for a paper all to itself. The phenomenon of "Karyoikinensis," or method of division of the cell nucleus, has only comparatively recently been thoroughly investigated. Then we have what is called "Continuity of the Protoplasm." Walter Gardiner and others have shown that in certain cases thin threads connect the protoplasm in adjacent cells, and that these threads can be made clearly visible by staining them with some suitable medium.

I have treated shortly of one group of cryptogams, but comparatively recently another of the groups of that division of the vegetable kingdom has been the subject of research, I refer to the Lycopodiums, or club mosses. Professor Treub, of the Buitenzorg Botanical Gardens, has filled in one or two phases of the life-cycle of these plants, having found their prothalli and traced the development of the same.

All this will show you that at present botany is not standing still, but that there are earnest workers doing good work.

USTILAGO MAYDIS.

By W. A. N. Dorland, M.D.

After briefly reviewing the history of cornsmut, the author relates his observations in nine cases in which the drug was employed, and then continues:

The above comprises all of the cases within the three months in which it was deemed necessary to employ the drug to shorten the duration of labor. Before proceeding, it may be as well to state that the patients were all in good physical condition, that all were at term, and that all made a rapid and complete recovery.

Having, now, this record before us, let us endeavor by a careful examination of the cases, to group the results of our experiments, that we may the more clearly ascertain the value of the drug. Three or four points seem to stand out prominently, demanding our consideration.

1. *The toxicology and physiological action of the drug.*

No cases of poisoning in man by the drug are on record. That it is, however, possessed of toxic properties in large doses has been proved by Mitchell.[1] He found that in the lower animals, in large doses, it acted violently upon the spinal cord, paralyzing first the sensory, later the motor tracts, finally involving the motor, and probably also the sensory neves. Like ergot, then, it is probable that the chief force of the drug, in toxic doses, is expended upon the nerve centres, producing a toxic paralysis.

As may be understood, our studies on the physiological action of ustilago were necessarily limited. After the administration of the drug in three instances, there was considerable nausea, followed in one case by vomiting of the ustilago, together with the other contents of the stomach. This nausea seems to be of a similar nature to that produced by the ergot of rye, and calls for no further discussion.

The action of ustilago upon the uterus has been more carefully noted. After the ingestion of a sufficient amount, in from twenty minutes to half an hour, the pains, if present, are increased in severity, in frequency, and in duration, presenting a marked *clonic* character, following each other in frequent succession, with a decided intermission between each. In this respect it differs decidedly from the action of ergot, which, in full doses, produces one continuous, *tonic* spasm of the uterine muscle. It is this property of ergot which has, when administered before the delivery of the placenta, produced in so many instances

1 Dr. James Mitchell, Inaug. Thesis, Univ. of Pa., 1883.

the irregular contractions of the uterus, of which the hour-glass is a well-known example. The employment of ustilago seems to be entirely free from such unpleasant complications.

In addition to being a valuable adjuvant in stimulating weak uterine contractions, ustilago seems to possess the property, which some years ago was ascribed to quinine, namely, of exciting uterine pains when entirely suspended. This has been noticed by Leonard and others.

As to the time required for the action of the drug to become apparent, it may be said that it differs in different cases, depending, undoubtedly, upon the rapidity with which it is absorbed from the gastro-intestinal tract and carried into the system. In the above record, in only two instances, did it require over thirty-five minutes before the ustilago acted upon the uterine tissues, and in the latter case most of the drug was ejected by emesis. In the remaining seven cases the average time required was twenty-five minutes.

The effect produced by ustilago upon the other unstriped muscular tissues of the body has not been inquired into. Probably it produces the same increase of intestinal peristalsis, and the same rise in the arterial pressure due to vasomotor spasm as is produced by ergot. This is yet open to investigation.

2. *The indications for the employment of the drug.*

It may be noticed that in all the above cases the ustilago was not administered until complete dilatation of the os had been accomplished. Whether or not a disastrous effect would be produced by the administration of the drug prior to the commencement of the second stage of labor cannot be stated. As yet, that question has not been decided. From the study of the physiological action of ustilago, we should think all danger of the irregular contractions of its compeer, the ergot of rye, would be precluded, and that if there were any possibilities of the exigencies of the case demanding its use, it might be employed with impunity during the first stage of labor. At present, however, we shall consider the first indication for its use to be the failure of the pains, with *complete dilatation of the os uteri.*

In none of the cases was the drug employed until the pains of labor had either become so weak that they were inefficient to accomplish the expulsion of the fœtus, or until they were entirely suspended. This, then, we consider the second indication for its use, namely, the *inefficiency or entire suspension of the parturient pain.*

After the ustilago had been taken, it may also be noticed that in no case was there the slightest tendency toward a post-partum hemorrhage. In each case after the expulsion of the placenta, the uterus remained in a state of firm contraction. While, during the three months the great majority of the remaining cases, in which the customary ergot had been employed, showed no tendency whatever toward this alarming accident, however, in two instances was there such an occurrence demanding prompt attention. The third indication, then, for the employment of ustilago we shall consider to be *a condition of uterine inertia threatening or producing post-partum hemorrhage.*

3. *The dose and mode of administration.*

The preparation of ustilago employed in all reported cases, as well as in our own, was a good fluid extract. The dose of this varies from one-half to two drachms, one drachm being a fair average. This may be repeated at intervals

as required. Should it be necessary, it may be used hypodermatically in doses of from five to fifteen minims.

Finally. *The advantages of ustilago over ergot.*

Dr. Frank H. Potter in a paper on the "Proper Use of Ergot in Obstetrical Practice," [1] closes his article with a series of ten conclusions. In these he states that when administered during labor the action of ergot is uncertain, producing irregular contractions, rigidity of the os, with interference of the placental circulation, or too rapid expulsion of the fœtus, jeopardizing the maternal tissues. He also asserts that the life of the child is endangered through absorption of the oil of ergot, and that indirectly the drug may prove a cause of puerperal septicæmia by preventing the removal of every portion of the placenta and membranes. His last conclusion is as follows: "The proper use of ergot in obstetrical practice is limited to those cases in which, after the expulsion of the placenta, the uterus refuses to contract, or having once contracted, shows a tendency to secondary relaxation. Even in these cases reliance should not be placed upon it alone, but its action should be supplemented by the other means used to provoke uterine contraction.

When compared to this formidable array of objections the employment of ustilago seems much to be preferred to that of ergot. It does not produce irregular contractions with all the consequent complications and sequelæ; containing but two and a half per cent. of fixed oil, while ergot contains from twenty-five per cent. to twenty-eight per cent., the dangers of absorption are reduced to a minimum; and, finally, as it can be procured at a cost of fifty per cent. less than that of ergot, it seems to be on a fair highway toward the supplanting of the latter in obstetrical practice, should the results of the investigations thus far be confirmed by subsequent researches.—*Med. News*, Nov. 5, 1887.

PHILADELPHIA HOSPITAL.

MINUTES OF THE PHARMACEUTICAL MEETING.

PHILADELPHIA, December 20, 1887.

The third of the present series of pharmaceutical meetings was held this day, Mr. William B. Webb in the chair. The report of the Survey of the Interoceanic Canal Route in Nicaragua; the report of the Bureau of Ethnology; the report of Education in Alaska; and several public documents issued by the Treasury Department, were reported as having been received for the library since the last meeting, from the Honorable M. S. Quay, United States Senator from Pennsylvania.

Mr. McIntyre presented a *bottle* of the old style, such as formerly graced the shelves of the apothecary stores, which he thought might fittingly find a place in the cabinet of antiquities.

A series of officinal *tinctures* were presented by Messrs. Bullock & Crenshaw to the cabinet. The chairman said he thought it quite desirable that a set of these preparations, made strictly according to the Pharmacopœia, should be in the museum.

Messrs. Johnson & Johnson presented specimens of *rubber* and *rubber plaster*

[1] Buffalo Med. and Surg. Journ., Sept. 1886, quoted in Therapeutic Gaz., Nov. 15, 1886.

masses, such as are used in the preparation of the plasters now so largely sold.

On motion, the thanks of the College were tendered to the givers for their kind remembrances.

Mr. H. J. M. Schrœter read a paper upon *Bitter Wine of Iron.* In response to a query whether the articles examined were those largely advertised, or those generally made by different pharmacists for their own sales, the reply was that the most advertised ones were not those examined. Bitter wine of iron had long been made before it was admitted in the Pharmacopœia. One member thought it originated with the senior Dr. Meigs; another, however, stated that Dr. Physic, or the elder Dr. Parrish, had prescribed it and given a formula for it.

A paper upon *Fluid Extract of Cimicifuga* was read by Mr. E. C. Lesher, who also exhibited the results of his experiments; and a paper upon *Fluid Extract of Asarum Canadense* was read by Mr. Frank P. Streeper. The papers were referred to the Committee on Publication. One of the members inquired whether the samples submitted had been filtered, and the reply was, that only one had been, the others retained their bright condition without any treatment.

Mr. Thompson thought this a proper occasion to have a general expression of opinion upon the subject, and said that every student should comprehend the importance of making his own pharmaceuticals; that they came here to obtain an education that fitted them to do so, and that it ought to be their aim and pleasure, as it is their profit, to do it. Mr. McIntyre said that the persons requiring medicines could be divided into two classes: those who got them of the doctors, and those who obtained them from apothecaries. Every druggist could prepare fluid extracts of the strength of half an ounce of drug to the fluidounce, and it was desirable that they so should be prepared; this would help both patient and apothecary. Mr. Thompson wished to hear Mr. Robbins express his opinion on this subject, as he had a very large experience in this matter. Mr. Webb inquired whether Mr. Robbins thought that a light drug, such as buchu or senna, could be exhausted with a quantity of liquid equal to the weight of the drug used. Mr. Robbins said that the drugs just named doubtless could be exhausted. The opinion had been expressed heretofore that fluid extracts would be better made if prepared so that a fluidounce represented but half an ounce weight.

Mr. McIntyre showed specimens of blue and white *wrapping paper* of a character that would repel moisture, being thus better adapted to the use of putting up Seidlitz powders, and other substances of a hygroscopic character; the paper is that commonly known as parchment paper.

Mr. Thompson read a facetious article, an "Epitaph on a Chymist," taken from a publication dated about 1800.

A member said that as the question of the revision of the Pharmacopœia was approaching, it would be desirable to ascertain the opinion of the members of the College upon the subject of parts by weight; it would probably be found that a large majority were not in favor of it.

There being no further business the meeting adjourned.

T. S. WIEGAND
Registrar.

CLASSES

—OF THE—

PHILADELPHIA COLLEGE OF PHARMACY,

SIXTY-SEVENTH ANNUAL SESSION, 1887-1888.

JUNIOR CLASS.

Name.	*Place.*	*State.*	*Preceptor.*
Allen, John Maskill,	Salem,	N. J.	James T. Shinn, Ph.G.
Amsden, William Cummings,	Manchester,	Iowa	L. Atwater & Son.
Anhalt, Herman,	Brooklyn,	N. Y.	Boericke & Tafel.
Arny, Harry Vin,	New Orleans,	La.	F. C. Godbold.
Aubley, Samuel,	Scottdale,	Pa.	J. M. McNeil.
Ayers, William Bishop,	Salisbury,	Md.	
Baird, John,	Philadelphia,	Pa.	Horace B. Taylor.
Barlemont, Phillip Louis,	Camden,	N. J.	J. Ames Lewis.
Barnitz, Lincoln Gray,	Catawissa,	Pa.	George W. Roland.
Bateman, Wm. Henry Stevens,	Mahanoy City,	Pa.	Thomas Lewis Jr., M.D.
Baur, Jr., William Christopher,	St. Clair,	Pa.	S. E. Walker.
Bender, John Jacob,	Shippensburg,	Pa.	J. C. Altick & Co.
Berkemeyer, Francis Molton,	Kutztown,	Pa.	Harrison Duffield, M.D.
Berkstresser, Watson J.,	Huntington,	Pa.	J. H. Black & Co.
Bickel, Harry Lee,	Felton,	Del.	M. M. Stevenson.
Bilheimer, John Jessiah,	Bath,	Pa.	Dr. G. P. Kern & Son.
Bissell, John Robertson,	Mahanoy City.	Pa.	C. D. S. Fruh, Ph. G. M. D.
Blake, Duncan Williamson,	Gloucester City,	N. J.	Dr. D. W. Blake.
Boger, Charles Everett,	Lebanon,	Pa.	
Bolton, Joseph Peeky,	Philada.,	Pa.	Wm. Conner, Ph. G.
Bowman, D. Buchanan,	Lancaster,	Pa.	Wm. G. Baker.
Boyer, Allen,	Allentown,	Pa.	W. E. Moyer.
Bradley, Augustus,	Tarboro,	N. C.	W. H. Macnair.
Bradley, Henry Joseph,	Philada.,	Pa.	J. F. Hayes, Ph. G.
Brennan, John Thomas,	Philada.,	Pa.	Cruice & Farrelly.
Brick, Harry Walter,	Philada.,	Pa.	Bullock & Crenshaw.
Bright, William Willets,	Muncy,	Pa.	G. F. Hart.
Brown, Barton L.,	Pleasant Grove,	Pa.	J. Harry Love, Ph. G.
Brown, Charles,	Philada.,	Pa.	Kennedy & Lyman.
Brown, Walter Lee,	Camden,	N. J.	Albert P. Brown, Ph. G.
Buckner, John Armstrong,	Pleasant Hill,	Mo.	F. T. Buckner, M. D.
Burget, Harry Edward,	Terre Haute,	Ind.	W. C. Buntin.
Butterworth, Francis James,	Lenni,	Pa.	Chas. L. Lashelle.
Cadmus, Alfred Brooks,	Philada.,	Pa.	Bullock & Crenshaw.
Caldwell Florence, Moore,	Philada.,	Pa.	Dr. S. W. Caldwell.
Campbell, Clarence Henry	Easton,	Md.	Milton Campbell.
Carney, George Elmer,	Philada.,	Pa.	Hance Bros. & White.
Caritte, Clarence Edgar,	St. Paul,	Minn.	J. P. Caritte.
Cartwright, Benjamin Franklin,	Philada.,	Pa.	Dr. Wm. Delker.
Casey, Henry English,	Philada.,	Pa.	Bullock & Crenshaw.

Name.	*Place.*	*State.*	*Preceptor.*
Cassaday, Frank Valorus,	Alliance,	Ohio	A. S. Cassaday.
Cassidy, John,	Philada.,	Pa.	W. H. Pile & Sons.
Cheney, William Lafayette,	Winchester,	Ind.	Dr. J. M. Carver.
Christman, Albert,	Allentown,	Pa.	E. J. Danowsky.
Clabaugh, Edgar Michael,	Altoona,	Pa.	D. G. Hurley, Ph. G.
Clapham, Benson Grant,	Mifflinburg,	Pa.	Charles Clapham.
Clarke, E. Edwin,	Bradford,	Pa.	Thompson & Wood.
Clavin, James,	San Antonio,	Texas	Wm. Robert Clavin.
Clewell, William Henry,	Holmesburg,	Philada.	Fred. C. Orth, Ph. G.
Cline, John Halliday,	Middleport,	Ohio	E. Davis & Co.
Codville, Henry Lawson,	Philada.,	Pa.	C. D. E. Ball.
Coll, Thomas,	Philada.,	Pa.	Bullock & Crenshaw.
Collings, Walter Nagle,	Philada.,	Pa.	D. W. Flemming.
Cooling, Benoni,	Charlestown,	Md.	J. S. Beetem, Ph. G.
Cooper, Percival Valentine,	Media,	Pa.	W. E. Dickeson.
Copeland, Harry Thompson,	Paterson,	Pa.	W. H. Banks. & Co.
Cottam, Charles Marquis,	Beaver Falls,	Pa.	J. Fajans.
Cotton, Frank Wilbert,	Bordentown,	N. J.	George M. Carslake.
Craig, George Tindall,	Wilmington,	Del.	Z. James Belt.
Crane, William Howard,	Philada.,	Pa.	A. R. Finck, M.D.
Crawford, Archie Darrah,	Norristown,	Pa.	William Stahler.
Crawford, Walter Beatty,	Chambersburg,	Pa.	Cressler & Greenawalt.
Cunningham, George Adams,	Selma,	Ala.	Cawthon & Coleman.
Dalton, Joseph Edwin,	Upland,	Pa.	F. E. Himmelwright, M.D.
Daniels, Willaim Joseph,	Pueblo,	Col.	A. E. Daniels.
Davis, Pierre Beaumont,	Gainesville,	Texas	Chas. Shivers.
Day, Frederick Samuel,	Philada.,	Pa.	Warrington & Pennypacker.
Deitz, George Arthur, Jr.,	Chambersburg,	Pa.	Wm. L. Cliffe.
De La Coúr, Joseph Carl,	Camden,	N. J.	J. C. De La Coúr.
DeLester, Ferdinand Raymond,	Kœningsberg,	Germ'y	Henry Cox, Ph. G.
Derbyshire, Alexander James,	Laurel,	Ind.	G. B. Evans, Ph. G.
Devine, Oliver Crawford,	Philada.,	Pa.	Dr. McVicker.
Dietz, Charles James,	Philada.,	Pa.	F. W. E. Stedem Ph. G.
Dorman, William Albert,	Hartleton,	Pa.	M. L. Mench, M.D.
Drake, Arthur,	Higginsport,	Ohio	Dr. H. S. Guthrie.
Du Bois, Samuel Conier,	Philada.,	Pa.	J. R. Elfreth.
Eft, Frederick,	Palatine,	N. J.	Dr. C. G. Frowert.
Eldredge, Clarence Selby,	W. Cape May,	N. J.	Drs. Marcy & Mecray.
Eldridge, Clarence Lewis,	Camden,	N. J.	French, Richards & Co.
Enders, William James,	Harrisburg,	Pa.	Fred. Rapp, Ph. G.
Engelman, Henry Schaeffer,	Cherry Hill,	Pa.	Weaver & Hohl.
Ensminger, Sam'l Chas, Deeg.,	Philada.,	Pa.	A. F. Gerhard, Ph. G.
Faries, Joseph Benjamin,	Smyrna,	Del.	S. P. Wright, Ph. G.
Fehr, George W.,	Landingville,	Pa.	Albert Cable.
Feidt, George David,	Hagerstown,	Md.	Blew & Lucas.
Fiet, Harry Jacob,	Philada.,	Pa.	P. G. Weber.
Finkeni, William Casper,	Camden,	N. J.	G. W. Henry, Ph. G.
Fisher, George Frank,	Altoona,	Pa.	C. B. Baumgardner.
Fite Thomas Duncan, Jr.,	Nashville,	Tenn.	
Fleming, Lizzie,	Ayr,	Neb.	A.H.Keller, Ph.G., M.D
Foulkes, Stephen Harvey,	Terre Haute,	Ind.	J. F. Gulick,
Fraunfelder, Richard Deily,	Easton,	Pa.	Dr. T. H. Reaser.
Freeman, Clayton Lewis,	Freemansburg,	Pa.	O. J. Freeman, Ph. G.
French, Francis Freas,	Philada.,	Pa.	W. H. Koons, Ph. G.
Frizzell, George F.,	Henry Clay,	Del.	E. T. Dilworth.
Frontz, Edward Elmer,	Hughesville,	Pa.	A. B. Wenrich, Ph. G.
Galbraith, Frank Melton,	Chester,	S. C.	Dr. A. H. DaVega.
Gano, Frank Kreamer,	Trenton,	N. J.	W. H. Mickle.
Ganster, William Foster,	Reading,	Pa.	F. X. Wolf.
Gerheart, William Henry,	Philada.,	Pa.	J. J. Ottinger, Ph. G.

Name.	*Place.*	*State.*	*Preceptor.*
Geilfuss, Alfred Victor,	Philada.,	Pa.	F. F. Williams, Ph. G.
Gerlach, Gustave,	Philada.,	Pa.	C. M. Edwards, Ph. G.
Glenk, Robert,	Philada.,	Pa.	Julius Israel.
Goll, Philip,	Wiltensee,	Germ'y	W. J. Schaeffer.
Gottwerth, William Lewis,	Wilmington,	Del.	T. B. Cartmell.
Gould, Harry Zinn,	Lebanon,	Pa.	S. A. Haverstick.
Gracey, Archibald Alexander,	Philada.,	Pa.	J. E. Loughlin.
Greenfield, Lewis Thompson,	Carlisle,	Pa.	H. C. Blairs' Sons.
Griffin, Howard Ezra,	Scranton,	Pa.	Charles Henwood.
Guthrie, Clinton,	Wilkesbarre,	Pa.	W. D. White.
Habliston, Walter Crawford,	Philada.,	Pa.	Wiley & Harris.
Hackney, George Wiley,	Uniontown,	Pa.	H. S. Clark.
Haines, Amos Henry,	Baltimore,	Md.	Dr. W. A. Davis.
Hall, Marlborough,	Philada.,	Pa.	Charles Ouram, Ph. G.
Hall, Walter Howell,	Wheeling,	W. Va.	Alex. T. Young.
Hance, Edward Hance, Jr.,	Germantown,	Pa.	Hance Bros. & White.
Handler, William,	Cleveland,	Ohio	Henry Mueller, M. D.
Harpel, Luther Grant,	Lebanon,	Pa.	J. L. Lemberger, Ph.G.
Hatcher, Robert Anthony,	New Orleans,	La.	J. L. Lyons & Co.
Haupt, William Grant,	Hartleton,	Pa.	H. C. Blairs' Sons.
Hause, George Shearer,	York,	Pa.	Dr. N. H. Shearer & Co.
Hieges, William Smith,	York,	Pa.	Wm. Smith & Co.
Henry, Samuel Clements,	Washington,	D. C.	J. W. Ridpath, Ph. G.
Hertel, Frederick Gustave,	Nashville,	Ills.	Aschenbach & Miller.
Heyner, Edward George,	Cleveland,	Ohio	E. H. Evans.
Hickman, Thomas Elwood,	Lombard,	Md.	W. H. Hickman, M.D.
Hoffecker, Robt. Crockett,	Dover,	Del.	T. C. Tomlinson.
Hoffman, Erdman,	Leipsic,	Del.	J. M. Wert, M. D.
Horning, John,	Bethlehem,	Pa.	Walt. Crawford, Ph.G.
Hostetter, Andrew Greider,	Florin,	Pa.	John E. Groff.
Houghton, John Almer,	Salt Lake City,	Utah	J. F. Allen.
Howard, Carrie Emily, Mrs.,	Philada.,	Pa.	H. B. Snavely, Ph. G.
Howell, Samuel Emerson,	Camden,	Del.	C. E. Downes, M. D.
Hughes, Charles Collin,	Gulf Mills,	Pa.	F. H. Poley.
Hughes, Frank Stacker,	Bridgeport,	Pa.	James G. Wells, Ph.G.
Humason, Ivan,	Portland,	Oregon	W. M. Wisdom.
Jager, Charles Mathias,	Madison,	Ind.	Joseph S. De Loste.
James, Henry Hughes,	Wyoming,	Pa.	E. Wilson.
Jones, Will Lincoln,	Catasauqua,	Pa.	Wm. Heckenberger.
Kantner, Harry Baker,	Altoona,	Pa.	D. W. Levy.
Kappes, Jacob J.,	Zanesville,	Ohio	Hatton Bros.
Keller, Augustus Herman,	Philada.,	Pa.	A. G. Keller, Ph. G.
Kelly, John P.,	Elmira,	N. Y.	A. H. Baker, M. D.
Kendig, Allen Jesse,	Philada.,	Pa.	R. P. Marshall & Co.
Kennedy, Harry Milton,	Cape May,	N. J.	Dr. H. A. Kennedy.
Kern, Franklin,	Slatington,	Pa.	F. R. Pershing.
Kiger, Harry Stiles,	Wilmington,	Del.	H. C. Lintner.
Kilgus, John Frank,	Renovo,	Pa.	M. L. Clay.
Kilgus, William Michael,	Renovo,	Pa.	E. T. Swain.
Kingston, Charlie Davis,	Granby,	Mo.	Powers & Benton.
Kleinsteeber, William George,	Wilmington,	Del.	Emil Hertel, M. D.
Klopp, Henry Leinbach,	West Leesport,	Pa.	Sam'l H. Shingle, Ph.G.
Knowles, George Alexander,	Philada.,	Pa.	W. D. Kerr.
Krauss, Gustav Adolf,	Bremen,	Germ'y	Walt H. Smith, Ph. G.
Latin, Adolph,	Dayton,	Ohio	George Latin, Ph. G.
Leigh, Charles Neal,	Coxsackie,	N. Y.	H. C. Manlove, Ph. G.
Leine, Arthur Morris,	Honesdale,	Pa.	N. G. Ritter, Ph. G.
Lesher, John Becker,	Shoemakersv'e,	Pa.	E. W. Sharp
Lingle, Milton David,	West Hanover,	Pa.	Dr. W. C. Kline.
Lonsway, Albert Russel,	Tiffin,	Ohio	Howard G Shinn, Ph.G

Name.	*Place.*	*State.*	*Preceptor.*
Loveland, Prescott Raymond,	Mt. Holly,	N. J.	Geo. M. Smyser, Ph. G.
Lowenberg, Joseph,	Bloomsburg,	Pa.	N. J. Hendershott.
Ludlam, Paul Thomas,	Millville,	N. J.	Mulford Ludlam.
Luff, J. Homer,	Felton,	Del.	J. S. Beetem. Ph. G.
Lutz, William Dellet,	Germantown,	Pa.	L. A. Treichler.
Mack, John Sanford,	Slatington,	Pa.	J. E. Williams.
Macon, Gideon Hunt,	Warrenton,	N. C.	Frank P. Hunter.
Mayers, Henry John,	Wheeling,	W. Va.	Will W. Irwin.
MacMillan, John Charles,	Latrobe,	Pa.	Wm. Fetter.
McClellan, Howard,	Cambridge,	N. Y.	H. G. South.
McCloskey, Charles Edward,	Knoxville,	Pa.	F. L. Gilbert.
McClure, Joseph Elmer,	Youngstown,	Ohio.	Folsom & Thayer.
McCorkle, William,	Oxford,	Pa.	Horace Moll & Co.
McCouch, Samuel Emlen,	Malvern,	Pa.	George R. Walton.
McFadden, Robert,	Philada.,	Pa.	Lewis F. Segrest, Ph.G.
McKee. Joseph Allen,	Altoona,	Pa.	Alton Clabaugh, Ph. G.
McKeel, Charles Baynor,	Washington,	N. C.	J. McDonald, M.D.
McKnight, Joseph Irwin.	Pittsburgh,	Pa.	H. G. Peters.
McManus, Joseph,	Philada.,	Pa.	F. G. Ryan, Ph. G.
McVay, James Patrick,	Philada.,	Pa.	Frank E. Morgan, Ph.G.
McWilliams, Samuel,	Jennersville,	Pa.	T. L. Buckman, Ph. G.
Medara, Thomas Joseph,	Philada.,	Pa.	H. B. Taylor, Ph. G.
Meredith, Charles Clyde,	Palatine,	W. Va.	A. W. Taylor, M.D.
Merkel, William,	Minersville, Pa.,		John M. Bradford, Ph. G., M.D.
Miller, Charles Borden,	Goldsboro,	N. C.,	Miller & Shannon.
Miller Solomon,	Hagerstown,	Md.	S. E. R. Hassinger, Ph. G.
Mittelbach, Henry,	Booneville,	Mo.	William Mittlebach.
Mohn, John Ellsworth,	Centreville,	Pa.	J. W. Sampsell, M. D.
Moody, Willie Bossieux,	Richmond,	Va.	W. L. Moody.
Morgan, George Irving,	Lynn,	Mass.	F. E. Morgan, Ph. G.
Morris, Joseph Garrison,	Seaville,	N. J.	Edward W. Sharp.
Morris, Wm. Henry,	Philada.,	Pa.	Geo. Holland. M.D.
Moyer, Reuben Emanuel,	Robisonia,	Pa.	Zeigler & Smith.
Murray, Emmett Leroy,	Americus.	Ga.	J. A. & D. F. Davenport.
Murray, James Joseph,	Reading,	Pa.	J. H. Stein, Ph. G.
Mustard, John, Jr.,	Smyrna,	Del.	J. W. Denney.
Neville, William,	Conshohocken,	Pa.	James W. Harry.
Newton, Alexander Bunyun,	Germantown,	Pa.	John Leedom Kooker.
Nichols, John Baugh,	Philada..	Pa.	W. R. Warner & Co.
Nyce. Howard Markley,	Worcester,	Pa.	G. B. Evans.
Orr, James Carson,	Philada.,	Pa.	George Holland, M. D.
Osmun, Milton Mackey,	Delaware,	N. J.	W. S. Freeman, Ph. G.
Owens, Harold Duche,	Philada.,	Pa.	D. Marshall & Bro.
Owings, Osmond Young,	Winsboro,	S. C.	Chas. Shivers.
Palmer, Charles Walter,	Frenchtown,	N. J.	A. P. Williams.
Paules, William Rumbaugh,	Marietta,	Pa.	Dr. S. Y. Thompson.
Pentz, John Fleming,	Easton,	Pa.	C. E. Spenceley.
Peters, George Fegley,	Mauch Chunk,	Pa.	Jos. Lacier.
Pettit, Paris Chapman,	Elmira,	N. Y.	C. P. Pettit.
Pfeiffer, Charles Alfred,	Frederick,	Md.	J. H. Evans.
Porter, M. Arthur,	Canton,	Pa.	Mix & Whitman.
Potts, George Clinton,	Harrisburg,	Pa.	Dr. Weills.
Powell, Benajah Butcher,	Mount Holly,	N. J.	Henry Thornton, Ph.G
Purnell, Howard Garrett,	Georgetown,	Del.	A. W. Duvall, M. D.
Quackenbush, Fred Briggs,	Penn Yan,	N. Y.	W. W. Quackenbush.
Ramsay, Charles Carroll,	Floyd,	Iowa	J. Ellis, M. D.
Ray, George Herbert,	Portland,	Oregon	Plummer & Byerley.
Read, Ralph Maynard,	Osceola Mills,	Pa.	F. R. Read.
Reading, Joel Salter,	Lambertville,	N. J.	G. P. Scheehle, Ph. G.
Reese, Victor Beaumont,	Renovo,	Pa.	Howard Knight, Ph.G.

Name.	*Place.*	*State.*	*Preceptor.*
Reider, Edwin Stanton,	Williamsport,	Pa.	Duble & Cornell.
Reynolds, May,	Philada.,	Pa.	Susan Hayhurst, M. D.
Rhoads, Harry Paist,	Doylestown,	Pa.	T. E. Conard, M. D.
Richards, Davis Bruce,	Philada.,	Pa.	Wm. Weber, Ph. G.
Ridgway, Charles Alexander,	Hydetown,	Pa.	John H. Kerr.
Riggs, Sherman Merrill,	Decatur,	Ills.	Henry Smith.
Risley, Leon Stewart,	Manchester,	Conn.	W. A. Lowry.
Rolleston, Arthur Raymond,	Philada.,	Pa.	Harry Cox.
Roth, Samuel George Jeremiah,	Laurys,	Pa.	A. A. G. Stark, Ph. G.
Rudy, Jacob Albert,	York,	Pa.	Dr. C. B. Lowe, Ph. G.
Rutherford, Frank Park,	Cochranville,	Pa.	L. E. Sayre & Co.
Schetky, Lawrence Oliphant,	Mt. Holly,	N. J.	Bullock & Crenshaw.
Schlegel, Emil Julius,	Philada.,	Pa.	Ernest Schlegel.
Schloer, Charles Albert,	New York,	N. Y.	W. D. Stevenson.
Schminky, Allen Beecher,	Lykens,	Pa.	A. G. Stanley.
Schutzenbach, Augustus,	Harrisburg,	Pa.	C. M. Forney, Ph. G.
Schwab, Leslie Watts,	Decatur,	Ills.	A. J. Blaine.
Schwacke, Charles Albert,	Charlestown,	S. C.	August H. Schwacke.
Schwenk, William Henry,	Peoria,	Ills.	R. D. McDougal.
Scott, Theodore William,	Oak Hill,	Pa.	Chas. H. Clark.
Shreve, Joseph Frith,	Jacksonville,	Ills.	James Williams.
Sitgreaves, Wesley Cline,	Vincentown,	N. J.	F. Saunderson.
Small, John Hamilton,	York.	Pa.	Henry C. Blair's Sons.
Smith, Frederick William,	Loudonville,	Ohio	D. F. Shull & Co.
Smith, George Anselm,	Nazareth,	Pa.	Babp & Crawford.
Smith, Harry C.,	Millville,	N. J.	W. H. Smith, M.D.
Smith, Harry Lawrence,	Philada.,	Pa.	Dr. A. N. Tomlin.
Smoker, Howard Grant,	Columbia,	Pa.	P. S. Brugh.
Southerland, Thomas Raibe,	Wilmington,	N. C.	J. H. Hardin.
Sprissler, C.,	Philada.,	Pa.	Theo. Sprissler, Ph. G.
Stackhouse, Clifton Taylor,	Philada.,	Pa.	Oliver J. Freeman.
Steele, George Elmer,	Youngstowh,	Pa.	A. J. Kells.
Stephen, Willie Leisse,	Reading,	Pa.	John B. Raser, Ph. G.
Stoever, Harry Van Hoff,	Chester,	Pa.	J. M. Stoever. Ph. G.
Tafel, Adolph Leonard,	Philada.,	Pa.	Boericke & Tafel.
Thomas, Harry Wyche,	Valdosta,	Ga.	Dr. Thomas.
Thompson, Ebenezer Francis,	Titusville,	Pa.	E. K. Thompson.
Upham, Samuel W.,	Bath,	N. Y.	J. Dunn.
VanValzah, John Adams,	Watsontown,	Pa.,	W. D. Heiser.
Visanska, Samuel Albert,	Abbeville,	S. C.	Givin & Co.
Vogelsang, Charles F. L.	South Oil City,	Pa.	W. J. Pechin.
Wagaman, Samuel Edward,	Chambersburg,	Pa.	J. S. Nixon & Son.
Watkins, Edward Howell,	Girardville,	Pa.	G. W. Storie.
Weaber, Charles Henry,	Fredericksburg,	Pa.	Dr. M. T. Reeder.
Weil Joseph L.,	Reading,	Pa.	Jas. C. Sanderson.
Weiser, Walter Rupert,	York,	Pa.	D. F. Shull & Co.
Wells, Frederick Barton,	Vineland,	N. J.	Dr. S. W. Gadd.
Westphal, Herman,	Hamburg,	Germ'y	Francis J. Kock.
White, Ishmael James,	Baltimore,	Md.	C. A. Lang.
Williams, Harry,	Laurel,	Del.	S. L. Kenny.
Williams, Solomon Cohen,	Charleston,	S. C.	A. R. Finck, M.D.
Williamson, James Strickler,	Harrisburg,	Pa.	Dr. Theodore Jacobs.
Wischman. Joseph Washington,	Philada.,	Pa.	Lewis Trupp, Ph. G.
Wishart, John Elmer,	Harrisonville,	Pa.	John B. Ferguson.
Witherow, John Howard,	Shippensburg,	Pa	J. C. Altick & Co.
Witmer, Albert Elam Ferree,	Philada.,	Pa.	D. L. Witmer & Bro.
Woertz, George Augustus,	Philada.,	Pa.	C. E. Hewitt, Ph. G.
Wolf, Frederick Joseph,	Philada.,	Pa.	R. Shoemaker & Co.
Wood, Harry Sudduth,	Maysville,	Ky.	James Shakelford, M.D.
Woods, John,	Philada.,	Pa.	H. L. Woods, M.D.

Name.	*Place.*	*State.*	*Preceptor.*
Worrall, Harry,	Downingtown,	Pa.	N. B. Danforth, Ph. G.
Wright, John Armstrong,	Philada.,	Pa.	A. W. Wright & Co.
Yale, William Ellsworth,	Allentown,	Pa.	H. E. Peters.
Yohn, Frank Jerold,	Pottstown,	Pa.	T. J. Hoskinson, Ph.G. M.D
Yost, Harvey B.,	Bethlehem,	Pa.	E. T. Meyers.
Young, Charles,	Johnstown,	Pa.	T. H. Potts, Ph. G.
Ziegel, Roger William,	York,	Pa.	S. M. Gable.
Zinnel, William Corson,	Philada.,	Pa.	Howard Knight, Ph.G.

SENIOR CLASS

Name.	*Place.*	*State.*	*Preceptor.*
Alwine, John. Jr.,	Philada.,	Pa.	Harrison Bros. & Co.
Amerman, Ella,	Danville,	Pa.	S. Hayhurt, M. D.
Angeny, Joseph S., Jr.,	Doylestown,	Pa.	Luther Gerhard.
Bachman, Chas. Fred.,	Sacramento,	Cal.	R. H. McDonald & Co.
Bacon, Francis Llewellyn,	Philada.,	Pa.	Robt. Shoemaker & Co.
Baird, Robert,	Amsterdam,	N. Y.	C. G. A. Loder.
Barrett, Charles Llewellyn,	Chester Co.,	Pa.	Daniel S. Jones, Ph. G.
Batdorff, Henry James,	Lykens,	Pa.	A. H. Bolton.
Bear, John H.,	Mt. Joy,	Pa.	E. B. Garrigues & Co.
Beckwith, James Webb,	Elmira,	N. Y.	Kennedy & Burke,
Bell, James Edgar Stevenson,	Los Angeles,	Cal.	Davis & Whisler.
Benerman, Alan Herbert,	Philada.,	Pa.	J. F. Hayes, Ph. G.
Benner, Isaac,	Philada.,	Pa.	O. H. Stermer.
Bennum, Charles Henry,	Georgetown,	Del.	Harry Swain, Ph. G.
Bently, David Fuller,	Conshohocken,	Pa.	Robt. Shoemaker & Co.
Bippus, Charles William,	Bellaire,	Ohio	C. E. Hewitt, Ph. G.
Birch, Harry Rees,	Philada.,	Pa.	Bullock & Crenshaw.
Blackburn, Robert Perry,	Lock Haven,	Pa.	T. C. Hilton & Co.
Blouch, Charles Henry,	Lebanon,	Pa.	
Bond, Ira Linton,	Tamaqua,	Pa.	John F. Bond.
Bowen, Charles Alfred,	Sennett,	N. Y.	A. G. Miller.
Bowers, Charles Edward,	Middletown,	Pa.	J. W. Rewalt
Bowker, Frank,	Camden,	N. J.	Geo. C. Webster, Ph.G.
Breidenbach, Charles Henry,	Dayton,	Ohio	Dr. W. A. Burns.
Buchanan, Frank,	Crum Lynn,	Pa.	C. H. Roberts, Ph. G.
Bunting, James Hicks,	Wilmington,	N. C.	John H. Hardin.
Burgess, Milton S.,	Cambridge,	Ohio	C. S. Wall & Co.
Burnett, J. Ames Howard,	Hackensack,	N. J.	Levi B. Hirst, Ph. G.
Butters, Charles Hayes,	Titusville,	Pa.	T. W. Reuting, Ph. G.
Cahill, Frank Joseph.	Trenton,	N. J.	J. E. Cahill.
Campbell, William H.	Philada.,	Pa.	
Cannon, C. Walton,	Bridgeville,	Del.	R. W. Cannon.
Carman, Frank Hamilton,	Pennsgrove,	N. J.	J. G. Howard.
Carroll, Sherman Lincoln,	Philada,	Pa.	A. Weber, Ph. G.
Castle, Abraham Lincoln,	Upland,	Pa.	A. S. Buchanan.
Cawley, Charles,	Manchester,	Iowa	E. J. Congar.
Christ, Frantz,	Philada.,	Pa.	J. D. Moore, Ph. G.
Clark, William Henry,	Madrid,	N. Y.	Parke Davis & Co.
Coleman, Fred'k Frelinghuysen,	Asbury Park,	N. J.	J. B. Moore.
Codville, Wm. L.	Philada.,	Pa.	C. G. A. Loder.
Cope, Frank Henry,	Philada.,	Pa.	W. A. Auffurth, M. D.
Copeland, George Hogan,	Renovo,	Pa.	Hall & Bro.
Courson, Harry Stockton,	New Berry,	Pa.	Wilbur F. Crawford.
Crass, John Henry,	Bridgeton,	N. J.	Chas. H. Clark, Ph. G.

Name.	*Place.*	*State.*	*Preceptor.*
Crawford, Martyn Payne,	Mifflintown,	Pa.	L. Banks & Co.
Crumbic, George Joseph,	Philada.,	Pa.	Decatur Milligan.
Crutcher, William,	Louisville,	Ky.	J. Oxley.
Culin, Walter,	Philada.,	Pa.	W. S. Reeve.
Davies, William Owen,	Slatington,	Pa.	J. A. Wiegner, Ph. G.
Davis, Clayton Erwin,	Florence,	Mass.	Nelson A. Davis.
Davis, Edward,	Minersville,	Pa.	D. R. Davis.
Davis, John Stephen Voorhees,	Wilmington,	Del.	Bullock & Crenshaw.
Davison, Joseph Childs,	Washington,	D. C.	A. D. Cuskaden.
Dean, Malcolm Graeme,	Newtown,	Pa.	I. J. Grahame.
DeHaven, Samuel Robert,	Toledo,	Ohio	A. Heitzman.
Demoville, James Louis,	Nashville,	Tenn.	Demoville & Co.
Donaldson, Thomas,	Wilmington,	Del.	N. B. Danforth, Ph. G.
Donnell, George James,	Clifton Heights,	Pa.	Geo. E. Dennison.
Dunn, Clifford,	Chicago.	Ills.	W. R. Warner & Co.
Durell, Kinsey Embury,	Philada.,	Pa.	J. W. Kohlerman.
Dyer, Charles Ellsworth,	Topeka,	Kansas	J. K. Jones.
Eads, Robert I.	Ashland,	Ky.	John C. Maisch.
Edenborn, Chas. Wesley Simons,	Philada.,	Pa.	L. G. Bauer, Ph. G.
Eisenhart, Edwin Kammerer,	Bingen,	Pa.	R. F. Babp.
Elfreth, Jr., Caleb Pierce,	Philada.,	Pa.	C. P. Elfreth.
Evans, Charles Born,	Harrisburg,	Pa.	James A. Myers.
Evans, William,	Philada.,	Pa.	J. B. Reynolds.
Fegley, Oscar George,	Pottsville,	Pa.	J. S. Ward, M. D.
Fletcher, Benjamin Kennard,	Philada.,	Pa.	J. D. McFerren.
Frantz, Wil. Lintner,	Lancaster,	Pa.	G. W. Hutt.
Franz, Frederick W.	Sioux City,	Iowa.	F. Hansen.
Froelick, Walter Scott,	York,	Pa.	B. S. Gilbert, Ph. G., & Co.
Gabell, Cromwell Pearce,	Florence,	N. J.	Bullock & Crenshaw.
Gallaher Charles Sumner,	Neillsville,	Wis.	Chas. C. Smiteman.
Green, Philip Henry,	Reading,	Pa.	Henry A. Borell, Ph. G.
Groom, Joseph,	Philada.,	Pa.	Hance Bros. & White.
Gros, Lucian Alfred,	San Francisco,	Cal.	Samuel S. Bunting.
Grosse, Gottlieb Matthew,	Cleveland,	Ohio	C. H. Bohn.
Greenfield. Oliver Roat,	Wilmington,	Del.	H. K. Watson.
Haak. Harry Capp,	Pine Grove,	Pa.	John B. Raser, Ph. G.
Haley, John Joseph,	Germantown,	Pa.	M. Kratz, Ph. G.
Hauck, Samuel Light,	Lebanon,	Pa.	Jefferson Hospital.
Haussmann, Frederick William,	Philada.,	Pa.	Christian Weis.
Hazel, Thomas Harold,	Cressona,	Pa.	Irwin L. Lautenbacher.
Hebsacker, William Frederick,	Philada.,	Pa.	J. Wendel.
Heffley, Harry Baker,	Somerset,	Pa.	E. & G. A. Fruh.
Hellmich, M.,	Philada.,	Pa.	G. H. Ochse.
Hennessy, Sherman Francis,	Pottsville,	Pa.	C. H. Wagner.
Hetherington, Thomas,	Philada.,	Pa.	Wetherill & Bro.
Hibshman, Paul Robert,	Myerstown,	Pa.	Bullock & Crenshaw.
Hoch, Aquila,	Bushkill Centre.	Pa.	W. H. Lantz.
Hooper, Sidney L.,	East New Market,	Md.	Bullock & Crenshaw.
Hume, Ward Dutcher,	Minneapolis,	Minn.	Robert McNeil, Jr.
Iobst, Frederick John,	Emmaus,	Pa.	George E. Dahis, Ph. G.
Jacobs, Eugene Jacob,	Atlanta,	Ga.	Joe Jacobs.
Jacobs, John Penn Jones,	Hollidaysburg,	Pa.	P. W. Snyder.
Johnson, Claude Grant,	Cumberland,	Md.	H. Laney.
Johnson, Frank R.,	Chester,	Pa.	G. Banks Wilson, Ph. G.
Johnson, Frederick Leighton,	Cape May,	N. J.	
Johnson, William A. S.	Charlottetown,	Canada	Apothecaries Hall Co.
Jones, Lysander Mann,	Canton,	Pa.	James O. Whitman,
Jones, Peter Lawrence,	Jamestown,	N. Y.	A. F. Johnson.
Jones, William Carrell,	New Egypt,	N. J.	J. Harley Compton.
Judge, John Aloysius,	Philada.,	Pa.	Carpenter, Henszey & Co.

Name.	*Place.*	*State.*	*Preceptor.*
Kalteyer, William Charles,	San Antonio,	Texas	George H. Kalteyer.
Kappes, Frederick Franklin,	Zanesville,	Ohio	W. H. Carslake Ph. G.
Keefer, Charles De Walt,	Chambersburg,	Pa.	C. H. Cressler.
Kennedy, Albert Dennis,	Philada.,	Pa.	A. Nebeker, M. D.
Klopp, Peter Paul,	N. Heidelberg,	Pa.	N. Davis, Ph. G.
Kraemer, Henry,	Philada.,	Pa.	Dr. Clement B. Lowe, Ph.G.
Krider, Richard C.,	Philada.,	Pa.	Stryker & Ogden.
Kuder, William,	Leetonia,	Ohio	H. H. Ink & Co.
Lammer, Henry Bruno,	Philada.,	Pa.	Bullock & Crenshaw.
Leitch, Charles Thomas,	Quakertown,	Pa.	C. W. Clymer & Co.
Lenhardt, Oliver F.,	Lancaster,	Pa.	A. A. Hubley.
Lesher, Edwin C.,	Kutztown,	Pa.	H. G. Haring, Ph. G.
Lewis, Griffith Robert,	Catasauqua,	Pa.	Edward D. Boyer.
Lippen, Harry,	Salem,	N. J.	H. M. Levering.
Livezey, John Bennett,	Doylestown,	Pa.	Dr. G. T. Harvey.
Ludlam, William Hall,	Brooklyn,	N. Y.	C. H. Gubbins, Ph. G.
Lynch, Albert James,	Woodstock,	Canada	Garden Bros.
Lyons, George,	Philada.,	Pa.	Beates, Miller & Lambert.
Macarthy, Frank Hamilton,	Berwyck,	Pa.	Grove & Kisner.
Macpherson, Frank Street,	Trenton,	N. J.	L. H. Street.
Madeira, Robert Wesley,	Shoem'krsville,	Pa.	John B. Raser, Ph. G.
Maris, Robert Wood,	Philada.,	Pa.	S. C. Webster, Ph. G.
May, John Aj.,	Manchester,	Ohio	C. C. Spannagel.
McCandless, Edward Sloan,	Philada.,	Pa.	J. W. Frey.
McClellan, Leslie Corwin,	Denver,	Col.	E. L. Scholtz.
McClure, Berthier,	Milton,	Pa.	Dr. E. S. Heiser.
McDowell, Charlie Hunt,	Lambertville,	N. J.	S. W. Cochran.
McIntosh, John R.,	Galion,	Ohio	B. N. Bethell, M. D.
McMechen, Wm. Benj.,	Wheeling,	W. Va.	W. H. Williams.
McNair, Edward Dudley,	Tarboro,	N. C.	L. C. Funk, Ph. G.
McNeil, Robert Carson,	Philada.,	Pa.	Robert McNeil, Jr.
Meissner, Frederick William,	La Porte,	Ind.	Eli Lilly's Sons.
Meyers, Harry Joseph,	Bethlehem.	Pa.	E. T. Meyers.
Miles, Chas. John Austin,	Manchester,	N. J.	R. W. Cuthbert, Ph. G.
Müntzer, William Christian,	Evansville,	Ind.	W. F. Epmeier.
Moffet, John,	Philada.,	Pa.	John Moffet.
Moller, John Daniel,	Philada.,	Pa.	Dr. Lamparter.
Moody, Thomas Frank,	Cuthbert,	Geo.	J. W. Stanford.
Moore, Edward, Jr.,	Media,	Pa.	Robert T. Grime.
Morison, John Lewis Dales,	Morton,	Pa.	W. E. Dickeson, Ph.G.
Moss, William,	Akron,	Ohio	H. H. Ross.
Muir, John Roy,	Lock Haven,	Pa.	W. A. Rumsey, Ph. G.
Mumma, Frank Gereon,	Mechanicsburg,	Pa.	Dr. J. H. Boyer.
Murphy, Frank Edward,	Kansas City,	Mo.	J. A. Gallagher.
Murray, Harry Louis,	Philada.,	Pa.	Murray & Smiley.
Murray, Wm. Robert,	Harrisburg,	Pa.	A. W. Nunemacher.
Musgrave, Aaron Wallace,	Bloomsburg,	Pa.	L. E. Sayre.
Nardyz, Miss Emma Bour,	Philada.,	Pa.	Susan Hayhurst, M. D.
Neal, Charley Bodine,	Woodbury,	N. J.	A. S. Marshall, Ph. G.
Nolte, Henry Augustus,	Swedesboro,	N. J.	C. C. Hughes.
Nolting, Geo. William Fred.,	Seymour,	Ind.	J. A. Andrews.
Oerter, Albert Eugene,	Bethlehem,	Pa.	Simon, Rau & Co.
Ogden, Charles Shepperd,	Camden,	N. J.	W. F. Richards.
Painter, Howard Thatcher,	Darby,	Pa.	Harlan Cloud.
Palen, Joseph Alphonse,	Dubuque,	Iowa	G. F. Thorman.
Pfund, Harry Lewis,	Philada.,	Pa.	John A. Martin, Ph.G.
Pickett, Charles Torbert,	New Hope,	Pa.	H. C. Blair's Sons.
Pierce, William Abner,	West Chester,	Pa.	Thos. G. Pierce.
Pollock, Jr., Robert Blair,	Philada.,	Pa.	J. R. Elfeith, Ph. G.
Poppenhusen, Jr., Hy. Aug. Chas.	Washington,	Mo.	C. A. Werckshagen.

Name.	*Place.*	*State.*	*Preceptor.*
Porter, Clawford Washington,	Philada.,	Pa.	Jas. T. Shinn, Ph. G.
Pringle, Jr., James Maxwell,	Columbia,	S. C.	L. A. Podolski.
Rabenau, John Herman,	Pottsville,	Pa.	Herman Rabenau, Jr.
Ranftle, Oscar,	Long Is'd City,	N. Y.	W. E. Lee.
Rawlins, Wilbur Fisk,	Dover,	Del.	Givin & Co.
Rayner, Howard Lincoln,	Norristown,	Pa.	R. Shoemaker & Co.
Rea, John,	Chester,	Pa.	W. H. Farley.
Reck, Charles Lincoln,	Greenville,	Ohio	W. Delker, M. D.
Reed, Howard,	Doylestown,	Pa.	Edgar P. Paris.
Redner, Thaddeus Rowland,	Rowlandville,	Pa.	N. W. Hickman, Ph. G.
Reith, Emil,	Philada.,	Pa.	T. A. Walker.
Richards, Howard Newton,	Trenton,	N. J.	Irving W. Kelly, Ph. G.
Reidenauer, Frederic Philips,	Philada,	Pa.	Bullock & Crenshaw.
Rishell, John Dauberman,	Centre Hall,	Pa.	John Harris.
Rochrig, Albert Henry,	Pottsville,	Pa.	Geo. H. Roehrig, Ph. G.
Rosen, Gustave,	Louisville,	Ky.	F. V. Simms.
Rourke, Michael Joseph,	Reading,	Pa.	John A. Gingrich.
Ruoff, William,	Philada.,	Pa.	Daniel Follmer.
Ryan, David Stephen,	Scranton,	Pa.	John J. Davies.
Sandifer, Myron Harris,	Rock Hill,	S. C.	D. E. E. Zacherle.
Schlaepfer, August James,	Evansville,	Ind.	H. J. Schlaepfer.
Schleif, Jr., William,	Milwaukee,	Wis.	Aschenbach & Miller.
Schindel, Harry Ellsworth,	Philada.,	Pa.	L. C. Funk.
Schmitt, Herm'n Thad. Stevens,	Philada.,	Pa.	V. H. Smith & Co.
Schroeter, Hermann John M.,	Watertown,	Wis.	R. H. Brennecke.
Schuster, George Robert Wm.,	Washington,	D. C.	William J. Pechin.
Schulte, Henry,	Cincinnati,	Ohio	G. A. Appenzeller, Ph. G.
Seasholtz, Jacob Clay,	Sunbury,	Pa.	Jos. Rex Devon.
Seiffert, John Henry,	York,	Pa.	Wm. Smith & Co.
Shaw, Henry Burfield,	Philada.,	Pa.	A. L. Lumb.
Sherman, John Burnett,	Bristol,	Pa.	J. K. Young.
Shugar, William Grant,	Lebanon,	Pa.	W. S. Deininger.
Siggings, Frank Morris,	Youngsville,	Pa.	Dr. E. L. Siggins.
Simons, Robert,	Philada.	Pa.	W. R. Warner & Co.
Smedley, Albert Webster,	Chester,	Pa.	Wm. Procter, Jr., Co.
Smith Frank H.,	Quakertown,	Pa.	S. F. Penrose, Ph. G.
Smith, Howard Melanethon,	Scranton,	Pa.	C. D. S. Früh, Ph. G.
Smythe, Edward Stanhope	Bryan.	Texas	Dr. Port Smythe & Son.
Snyder, Bertram,	Philada.,	Pa.	J. H. Stermer.
Snyder, Henry Nissley,	Lancaster,	Pa.	Franklin P. Albright.
Snyder, Howard Grant,	Lancaster,	Pa.	J. R. Kauffman.
Snyder, William Lincoln,	Troy,	Ohio	
Sonntag, Max,	Philada.,	Pa.	Wm. K. Mattern, M. D.
Souder, George Reed,	Atlantic City,	N. J.	Souder & Bro.
Spear, Owen Crow,	Wilmington,	Del.	Dr. J. V. Blackson.
Staudt, Albert John,	Aurora,	Ill.	J. N. Standt.
Stelzer, Nathan Samuel,	Brooklyn,	N. Y.	Hibberd P. John, Ph. G.
Stengelin, William,	Easton,	Pa.	A. J. Odenwelder.
Stewart, Henry Clifton,	Wheeling,	W. Va.	Dr. Henry Mueller.
Stone, Mims Baker,	Birmingham,	Ala.	Amzi Godden.
Stratton, Charles Clark,	Woodstown,	N. J.	Barton & Andrews.
Strasser, John Jacob,	Trenton,	N. J.	F. R. Jummel.
Streeper, Frank Park,	Chestnut Hill,	Pa.	T. L. Buchman.
Strowbridge, George Hanson,	Portland,	Oregon	Plummer Bajerley.
Strunk, Lewis Curtin,	Quakertown,	Pa.	Wm. M. Brown.
Strunkel, John Louis,	Brownstown,	Ind.	Joseph A. Stillwell.
Supplee, Isaac Morris,	Conshohocken,	Pa.	Supplee & Bro.
Swartz, Charles Michael,	Hughesville,	Pa.	J. R. Swartz.
Swisher, David Falls,	Williamsport,	Pa.	B. A. Hertsch.
Switzer, L. Burt,	Bath,	N. Y.	J. P. Remington.

Name.	*Place.*	*State.*	*Preceptor.*
Taylor, Thomas Clarkson,	Wilmington,	Del.	Philip H. Wood.
Thompson, Herbert Moodie,	Thompsontown,	Pa.	Bullock & Crenshaw.
Thornton, Edward Quin,	Greensboro,	Ala.	A. Stollenwerck & Son.
Todd, James Charles,	Roxboro,	Philada.	Wm. C. Todd, M. D.
Frank, Charles Cowdrick,	Tinicum,	Pa.	Carpenter, Henzey & Co.
Travis J. Walton,	Cohoes,	N. Y.	W. F. Peters.
Tyler, Thomas Van Dyke,	Omaha,	Neb.	H. S. Bartlett.
Uller Emil Joseph,	Titusville,	Pa.	J. V. Antill.
Vandegrift. Wm. Hy. Flitcraft,	Philada.,	Pa.	Wm. Reisert.
Van Dyke, Wm. Clinton,	Van Dyke,	Pa.	Frank S. Keet.
Wagner, Robert Sydney,	Hartleton,	Pa.	M. L. Mensch, M. D.
Waldenberger, Louis,	Manayunk,	Pa.	Dr. Joseph Farley.
Wallace. Edwin Corby,	Springfield,	Ohio	R. Willard.
Wallace, Frank Brisben,	Abilene,	Kan.	R. H. De Huy.
Wallis, Frank James,	Philada.,	Pa.	J. M. Wallis, M. D.
Walls, Frank,	Milton,	Del.	A. W. Duvall, M. D.
Walton, Lucius L.,	Clinton,	N. J.	J. L. Hill, Ph. G.
Ward, Percy Hall,	Crisfield,	Md.	Hall & Atkinson.
Warren, Nathan Chew,	Upland,	Pa.	C. L. Lashelle, Ph. G.
Watson, Maurice,	Camden,	N. J.	Dr. Wm. Shafer.
Weber, William,	Philada.,	Pa.	August Weber.
Weiser, Frank Ressler,	Millersburg,	Pa.	J. E. Lehman, Ph. G.
Wetteroth, Henry,	Bordentown,	N. J.	Geo. M. Carslake, Ph.G.
Weyand, Wm. Jacob,	Philada.,	Pa	W. J. Shaeffer.
White, Edward Riall,	Salisbury,	Md.	Bullock & Crenshaw.
White, James Wesley,	Point Pleasant,	Pa.	Dr. Benjamin.
White, Robert Walter,	Chambersburg,	Pa.	W. E. Finney.
Williams, William J.,	Plymouth,	Pa.	Reese D. Williams.
Wishart, Frederick Gray,	Philada.,	Pa.	F. E. Harrison, Ph. G.
Woodruff, John Stewart,	Bridgeton,	N. J.	H. F. Seeley, Ph. G.
Wrigley, John Thomas,	Chester,	Pa.	J. F. Judd.
Wyeth, Maxwell,	Philada.,	Pa.	J. Wyeth & Bro.
Zane, James Stewart,	Glassboro,	N. J.	Dr. Souder.